PSD and Title V Permitting Guidance for Greenhouse Gases

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PSD and Title V Permitting Guidance for Greenhouse Gases

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Disclaimer

This document explains the requirements of EPA regulations, describes EPA policies, and recommends procedures for permitting authorities to use to ensure that permitting decisions are consistent with applicable regulations. This document is not a rule or regulation, and the guidance it contains may not apply to a particular situation based upon the individual facts and circumstances. This guidance does not change or substitute for any law, regulation, or any other legally binding requirement and is not legally enforceable. The use of non-mandatory language such as "guidance," "recommend," "may," "should," and "can," is intended to describe EPA policies and recommendations. Mandatory terminology such as "must" and "required" are intended to describe controlling requirements under the terms of the Clean Air Act and EPA regulations, but this document does not establish legally binding requirements in and of itself.

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I. Introduction

EPA is issuing this guidance document to assist permit writers and permit applicants in addressing the prevention of significant deterioration (PSD) and title V permitting requirements[1] for greenhouse gases (GHGs) that begin to apply on January 2, 2011. This document: (1) describes, in general terms and through examples, the requirements of the PSD and title V permit regulations; (2) reiterates and emphasizes relevant past EPA guidance on the PSD and title V review processes for other regulated air pollutants;[2] and (3) provides additional recommendations and suggested methods for meeting the permitting requirements for GHGs, which are illustrated in many cases by examples. We believe this guidance is necessary to respond to inquiries from permitting authorities and other stakeholders regarding how these permitting programs will apply to greenhouse gas (GHG) emissions.

This document is organized into sections with supporting appendices. Section I describes the purpose of this document, describes the actions that led to the permitting of sources of GHGs, and provides a general background for the permitting of major stationary sources. Section II describes PSD applicability criteria and how to determine if a proposed new or modified stationary source is required to obtain a PSD permit for GHGs. Section III discusses the process that EPA recommends following to determine best available control technology (BACT) for GHGs for new sources and modified emissions units. Section IV discusses how other PSD permitting requirements are generally inapplicable or have limited relevance to GHGs. Section V describes considerations for permitting of GHGs under title V of the Clean Air Act (CAA or Act). The appendices located at the end of this document include PSD applicability flowcharts for new and modified sources of GHGs, an example PSD applicability analysis for a modified source, example BACT analyses, compilations of resources for estimating emissions of GHGs and for finding control measures for sources of GHGs, and cost effectiveness calculation methodology.

EPA initially issued this GHG permitting guidance in November 2010. This version reflects a limited number of clarifying edits to the November 2010 guidance and replaces it.

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[1] Such requirements are reflected in provisions of the Clean Air Act, EPA rules, and approved State Implementation Plans. See 75 FR 17004 (Apr. 2, 2010).

[2] Collections of past EPA guidance on the PSD and title V review processes include:

- EPA websites listing some existing guidance documents for NSR (including PSD) (http://www.epa.gov/nsr/guidance.html) and title V (http://www.epa.gov/ttn/oarpg/t5pgm.html);
- Environmental Appeals Board (EAB) decisions on PSD permitting (http://yosemite.epa.gov/oa/EAB_Web_Docket.nsf/PSD+Permit+Appeals+(CAA)?OpenView) and title V permitting (http://yosemite.epa.gov/oa/EAB_Web_Docket.nsf/Title+V+Permit+Appeals?OpenView); and
- EPA Region 7's online searchable database of many PSD and title V guidance documents issued by EPA headquarters offices and EPA Regions (http://www.epa.gov/region07/air/policy/search.htm).

Most of the EPA documents cited in this document can be found in one of these locations. To the extent this guidance relies on a document that is not located in one of the above collections, we have attempted to provide a website link or other relevant information to help locate the document.

Relevant Background

New major stationary sources and major modifications at existing major stationary sources are required by the CAA to, among other things, obtain an air pollution permit before commencing construction. This permitting process for major stationary sources is called new source review (NSR) and is required whether the major source or major modification is planned for an area where the national ambient air quality standards (NAAQS) are exceeded (nonattainment areas) or an area where the NAAQS have not been exceeded (attainment and unclassifiable areas). In general, permits for sources in attainment areas and for other pollutants regulated under the major source program are referred to as prevention of significant deterioration (PSD) permits, while permits for major sources emitting nonattainment pollutants and located in nonattainment areas are referred to as nonattainment NSR (NNSR) permits. The entire preconstruction permitting program, including both the PSD and NNSR permitting programs, is referred to as the NSR program. Since EPA has not established a NAAQS for GHGs, the nonattainment component of the NSR program does not apply. Thus, the NSR portions of this guidance focus on the PSD requirements that apply once GHGs become a regulated NSR pollutant.

Major stationary sources and certain other sources are also required by the CAA to obtain title V operating permits. While title V permits generally do not establish new emissions limits, they consolidate requirements under the CAA, including applicable GHG requirements, into a comprehensive air permit.

Over the past year, EPA has taken several actions regarding GHGs under the CAA. The result of these EPA actions, explained in more detail below, is that certain PSD permits and certain title V permits issued on or after January 2, 2011, must address emissions of GHGs. These actions included new rules that established a common sense approach to phase in permitting requirements for GHG emissions from stationary sources, beginning with large industrial sources that are already subject to PSD and title V permitting requirements.

On December 15, 2009, EPA found that elevated atmospheric concentrations of six well-mixed GHGs, taken in combination, endanger both public health and welfare ("the endangerment finding"), and that the combined emissions of these GHGs from new motor vehicles cause and contribute to the air pollution that endangers public health and welfare ("the cause and contribute finding").[3] These findings did not themselves impose any requirements to control GHG emissions, but they were a prerequisite to finalizing GHG standards for vehicles under title II of the Act. Thereafter, on May 7, 2010, EPA issued a final rule – the Light-Duty Vehicle Rule (LDVR) – establishing national GHG emissions standards for vehicles under the CAA.[4] The new LDVR standards apply to new passenger cars, light-duty trucks, and medium-duty passenger vehicles, starting with model year 2012.

[3] 74 FR 66496 (Dec. 15, 2009).

[4] 75 FR 25324 (May 7, 2010). As part of this joint rulemaking, the Department of Transportation's National Highway Traffic Safety Administration (NHTSA) issued Corporate Average Fuel Economy (CAFE) standards for these vehicles under the Energy Policy and Conservation Act, as amended.

For stationary sources, on March 29, 2010, EPA made a final decision to continue applying (with one refinement) the Agency's existing interpretation regarding when a pollutant becomes "subject to regulation" under the Act, and thus covered under the PSD and title V permitting programs applicable to such sources. EPA published notice of this decision on April 2, 2010.[5] Under EPA's final interpretation, a pollutant becomes "subject to regulation" on the date that a requirement in the CAA or a rule adopted by EPA under the Act to actually control emissions of that pollutant "takes effect" or becomes applicable to the regulated activity (rather than upon promulgation or the legal effective date of the rule containing such a requirement). EPA's April 2, 2010 notice also explained that, based on the anticipated promulgation of the LDVR, the GHG requirements of the LDVR would take effect on January 2, 2011, if the LDVR was finalized as proposed for model year 2012 vehicles. Thus, under EPA's interpretation of the Act and applicable rules, construction permits issued[6] under the PSD program on or after January 2, 2011, must contain conditions addressing GHG emissions.

With respect to title V operating permits, the April 2, 2010 notice reiterated EPA's interpretation that the 100 tons per year (TPY) major source threshold for title V operating permits is triggered only by pollutants "subject to regulation" under the Act. EPA also explained that the Agency interprets "subject to regulation" for title V purposes in the same way it interprets that term for PSD purposes (*i.e.,* a pollutant is subject to regulation when an actual control requirement under the Act takes effect).

On June 3, 2010, EPA issued a final rule that "tailors" the applicability provisions of the PSD and title V programs to enable EPA and states to phase in permitting requirements for GHGs in a common sense manner ("Tailoring Rule").[7] The Tailoring Rule focuses on first applying the CAA permitting requirements for GHG emissions to the largest sources with the most CAA permitting experience. Under the Tailoring Rule, facilities responsible for nearly 70 percent of the national GHG emissions from stationary sources are subject to permitting requirements beginning in 2011, including the nation's largest GHG emitters (*i.e.,* power plants, refineries, and cement production facilities). Emissions from small farms, churches, restaurants,

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[5] 75 FR 17004 (April 2, 2010).

[6] Consistent with its regulations in 40 CFR Part 124, EPA uses the term "issued" to describe the time when a permitting authority issues a PSD permit after public comment on a draft permit or preliminary determination to issue a PSD permit. Depending on the applicable administrative procedures, the date a permit is issued is not necessarily the same as the date the permit becomes effective or final agency action for purposes of judicial review. Under EPA's procedural regulations, a permit is "issued" when the Regional Office makes a final decision to grant the application, not when the permit becomes effective or final agency action. 40 CFR 124.15; 40 CFR 124.19(f). EPA generally applies the requirements in effect at the time a permit is issued by a Regional office unless the Agency has expressed an intent when adopting a new requirement that the requirement apply to permits that were issued earlier but not yet effective or final agency action by the time the new requirement takes effect. *In re: Dominion Energy Brayton Point, L.L.C.*, 12 E.A.D. 490, 616 (EAB 2006). In its actions discussing the January 2, 2011 date when GHGs will become a regulated NSR pollutant, EPA did not indicate that GHG requirements should apply to any permits issued before January 2, 2011. Thus, EPA does not intend to require PSD permits that are issued (as described in 40 CFR 124.15) prior to January 2, 2011 to address GHGs, even if the permit is not effective until after January 2, 2011 by virtue of a delayed effective date or an appeal to the Environmental Appeals Board. See, 40 CFR 124.15(b); 40 CFR 124.19(f). A similar approach may be appropriate in states with approved PSD programs that have analogous administrative procedures.

[7] 75 FR 31514 (June 3, 2010).

and small commercial facilities are examples of source types that are not likely to be covered by these programs under the Tailoring Rule. The rule then expands to cover the largest sources of GHGs that may not have been previously covered by the CAA for other pollutants.

As discussed in detail below, under the Tailoring Rule, application of PSD to GHGs will be implemented in multiple steps, which we refer to in this document as "Tailoring Rule Steps" to avoid confusion with the five steps for implementing the "top down" best available control technology (BACT) analysis and the two steps of the applicability procedures for modifications. The first Tailoring Rule step begins on January 2, 2011, and ends on June 30, 2011, and this step covers what EPA has called "anyway sources" and "anyway modifications" that would be subject to PSD "anyway" based on emissions of pollutants other than GHGs. The second step begins on July 1, 2011, and continues thereafter to cover both anyway sources and certain other large emitters of GHGs. EPA has committed to completing another rulemaking no later than July 1, 2012, to solicit comments on whether to take a third step of the implementation process to apply the permitting programs to additional sources. EPA has also committed to undertaking another rulemaking after 2012. Sources subject to the permitting programs under the first two steps will remain subject to these programs through any future steps. Future steps are not discussed further in this guidance document, since the outcomes of those rulemaking efforts are not yet known. Under the Tailoring Rule, in no event are sources with a potential to emit (PTE) less than 50,000 TPY of CO_2 equivalent (CO_2e) subject to PSD or title V permitting for GHG emissions before 2016. For additional information regarding the steps of the PSD and title V implementation processes for GHGs, please refer to the preamble of the Tailoring Rule.[8]

This guidance does not reiterate all the provisions of the Tailoring Rule or other EPA rules; rather, it takes the applicable provisions and lays them out in a way designed to explain and simplify the procedures for applicants and other stakeholders going through the PSD and title V permitting processes. Should there be any inconsistency between this document and the rules, the rules shall govern.

The fundamental aspects of the PSD and title V permitting programs are generally not affected by the integration of GHGs into these programs. Therefore, this document does not elaborate on topics such as public notice requirements, aggregation of related physical or operational changes, the definition of a stationary source, debottlenecking, treatment of fugitive emissions, determining creditable emissions reductions, or routine maintenance, repair and replacement. Readers that are interested in understanding these aspects of the federal program should rely on current EPA rules and guidance when permitting GHGs.

EPA Regional Offices should apply the policies and practices reflected in this document when issuing permits under the federal PSD and title V permitting programs, unless the facts and the record in an individual case demonstrate grounds to approach the subjects discussed in a different manner. State, local and tribal permitting authorities that issue permits under a delegation of federal authority from EPA Regional Offices should do likewise. EPA also recommends that permitting authorities with approved PSD or title V permit programs apply the guidance reflected in this document, but these permitting authorities have the discretion to apply alternative approaches that comply with state and/or local laws and the requirements of the CAA

[8] 75 FR at 31522-525.

and approved state, local or tribal programs. As is always the case, permitting authorities have the discretion to establish requirements in their permits that are more stringent than those suggested in this guidance or prescribed by EPA regulations.[9]

[9] 42 USC 7416.

II. PSD Applicability

General Concepts

Under the CAA, new major stationary sources of certain air pollutants, defined as "regulated NSR pollutants," and major modifications to existing major sources are required to, among other things, obtain a PSD permit prior to construction or major modification. We refer to the set of requirements that determine which sources and modifications are subject to PSD as the "applicability" requirements. Once major sources become subject to PSD, these sources must, in order to obtain a PSD permit, meet the various PSD requirements. For example, they must apply BACT, demonstrate compliance with air quality related values and PSD increments, address impacts on special Class I areas (*e.g.,* some national parks and wilderness areas), and assess impacts on soils, vegetation, and visibility. These PSD requirements are the subject of Sections III and IV of this document.

In this section, we discuss how the CAA and relevant EPA regulations describe the PSD applicability requirements. The CAA applies the PSD requirements to any "major emitting facility" that constructs (if the facility is new) or undertakes a modification (if the facility is an existing source).[10] The term "major emitting facility" is defined as a stationary source that emits, or has a PTE of, at least 100 TPY, if the source is in one of 28 listed source categories, or, if the source is not, then at least 250 TPY, of "any air pollutant."[11] For existing facilities, the CAA adds a definition of modification, which, in general, is any physical or operational change that "increases the amount" of any air pollutant emitted by the source.[12]

EPA's regulations implement these PSD applicability requirements through use of different terminology, and, in the case of GHGs, with additional limitations. Specifically, the regulations apply the PSD requirements to any major stationary source that begins actual construction[13] (if the source is new) or that undertakes a major modification (if the source is existing).[14] The term major stationary source is defined as a stationary source that emits, or has a PTE of, at least 100 TPY if the source is in one of 28 listed source categories, or, if the source is not, then at least 250 TPY, of regulated NSR pollutants.[15] We refer to these 100- or 250-TPY amounts as the major source limits or thresholds.

A major modification is defined as "any physical change in or change in the method of operation of a major stationary source that would result in: a significant emissions increase [ ] of a regulated NSR pollutant [ ]; and a significant net emissions increase of that pollutant from the major stationary source."[16] EPA rules specify what amount of emissions increase is "significant" for listed regulated NSR pollutants (*e.g.,* 40 TPY for sulfur dioxide, 100 TPY for carbon

[10] 42 USC 7475(a), 7479(1).
[11] 42 USC 7479(1).
[12] 42 USC 7479(1), 7411(a)(4).
[13] 40 CFR 52.21(b)(11).
[14] 40 CFR 52.21(a)(2).
[15] 40 CFR 52.21(b)(1)(i).
[16] 40 CFR 52.21(b)(2)(i) and the term "net emissions increase" as defined at 40 CFR 52.21(b)(3).

monoxide), but for any regulated NSR pollutant that is not listed in the regulations, any increase is significant.[17]

A pollutant is a "regulated NSR pollutant" if it meets at least one of four requirements, which are, in general, any pollutant for which EPA has promulgated a NAAQS or a new source performance standard (NSPS), certain ozone depleting substances, and "[a]ny pollutant that otherwise is subject to regulation under the Act."[18] PSD applies on a regulated-NSR-pollutant-by-regulated-NSR-pollutant basis. The PSD requirements do not apply to regulated NSR pollutants for which the area is designated as nonattainment. Further, some modifications are exempt from PSD review (*e.g.*, routine maintenance, repair and replacement).[19]

For proposed modifications at existing major sources, PSD applies to each regulated NSR pollutant for which the proposed emissions increase resulting from the modification both is significant and results in a significant net emissions increase. This is true even if the increased pollutant is different than the pollutant for which the source is major. Thus, the regulations quoted above require a two-step applicability process for modifications. Step 1 involves determining if the modification by itself results in a significant increase. No emissions decreases are considered in Step 1.[20] If there is no significant increase in Step 1, then PSD does not apply. If there is a significant increase in Step 1, then Step 2 applies, which involves determining if the modification results in a significant net emissions increase. The Step 2 calculation includes creditable emissions increases and decreases from the modification by itself and also includes creditable emissions increases and decreases at the existing source over a "contemporaneous period." This period is defined in the federal regulations as the period that extends back 5 years prior to the date that construction commences on the modification and forward to the date that the increase from the modification occurs.

To determine PSD applicability of an existing stationary source, an owner or operator may use one of two tests to determine the emissions increase from an existing emissions unit: the actual-to-projected-actual" emissions test or the "actual-to-potential" emissions test.[21] If the emissions unit at an existing source is new, the owner or operator must use the "actual-to-potential" emissions test to calculate emissions increases. Also, the "baseline actual emissions" for existing emissions units are generally the actual emissions in TPY from the unit for any consecutive 24-month period (selected by the applicant) in the prior 10 years, or 5 years if the source is an Electric Generating Unit (EGU).[22] Assuming a source applies the actual-to-projected-actual applicability test for its modifications, it should be noted that some projects that sources undertake to improve the energy or process efficiency of their operations may not be subject to PSD review. This is because the increased efficiency of the project can translate into less raw material and/or fuel consumption for the same amount of output of product. Consequently, as long as the output from the affected unit(s) is not reasonably expected to increase, the projected actual annual emissions for all of the pollutants emitted from the process

[17] 40 CFR 52.21(b)(23)(i)-(ii).
[18] 40 CFR 52.21(b)(50).
[19] 40 CFR 52.21(b)(2)(iii).
[20] Letter from Barbara A. Finazzo, Region II, to Kathleen Antoine, HOVENZA LLC (March 30, 2010).
[21] 40 CFR 52.21(b)(41).
[22] 40 CFR 52.21(b)(48).

is likely be less than the baseline actual emissions, resulting in a no emission increase for the change in emissions of the pollutants using the actual-to-projected-actual applicability test.[23] Of course, other factors must be considered as well when calculating the projected actual annual emissions resulting from a modification (*e.g.,* whether the projected actual emissions increase could have been accommodated at the changed emissions unit(s) and is also unrelated to the particular project). These and other factors may influence whether a modification involving an energy or process efficiency improvement is subject to PSD.

Before beginning actual construction, a source may limit its PTE to avoid application of the PSD permitting program. To appropriately limit PTE, a source's permit must contain a production or operational limitation in addition to the unit-specific emissions limitation in cases where the emissions limitation does not reflect the maximum emissions of the source operating at full design capacity. Restrictions on production or operation that limit a source's PTE include limitations on quantities of raw materials consumed, fuel combusted, hours of operation, or conditions which specify that the source must install, operate, and maintain controls that reduce emissions to a specified emission rate or to a specified control efficiency. Production and operational limits must be stated as conditions that can be enforced independently of one another. For example, restrictions on fuel that relate to both type and amount of fuel combusted should state each as an independent condition in the permit. This is necessary to make the PTE restrictions enforceable as a practical matter.[24]

As an alternative applicability procedure, applicants may secure an enforceable plantwide applicability limit (PAL) in TPY at existing major stationary sources for one or more regulated NSR pollutants prior to any modification.[25] Once properly established in the source's permit, subsequent modifications to existing emissions units, or the addition of new emissions units, are not subject to PSD for the PAL pollutant if the emissions of all emissions units under the PAL remain below the PAL limit and all other PAL requirements are met.

GHG-Specific Considerations

Beginning on January 2, 2011, GHGs are a regulated NSR pollutant under the PSD major source permitting program when they are emitted by new sources or modifications in amounts that meet the Tailoring Rule's set of applicability thresholds, which phase in over time. For PSD purposes, GHGs are a single air pollutant defined[26] as the aggregate group of the following six gases:

- carbon dioxide (CO_2)
- nitrous oxide (N_2O)
- methane (CH_4)
- hydrofluorocarbons (HFCs)

[23] The source must be able to substantiate its projections, and if it fails to do so or if it fails to operate its unit in accordance with their projection, PSD may apply.
[24] *See, generally,* EPA Guidance on Limiting Potential to Emit (PTE) in New Source Permitting (June 13, 1989), available at http://www.epa.gov/reg3artd/permitting/t5_epa_guidance.htm.
[25] 40 CFR 52.21(a)(2)(v), (b)(2)(iv) and (aa)(1)(ii).
[26] 40 CFR 52.21(b)(49)(i).

- perfluorocarbons (PFCs)
- sulfur hexafluoride (SF_6)

Specifically, in Tailoring Rule Step 1, beginning on January 2, 2011, and continuing through June 30, 2011, GHGs that are emitted in at least specified threshold amounts from a new source that is subject to PSD anyway, due to emissions of another regulated NSR pollutant, are subject to regulation and therefore a regulated NSR pollutant from that source. By the same token, when an existing major source undertakes a physical or operational change that would be subject to PSD anyway due to emissions of another regulated NSR pollutant and increases its emissions of GHGs by at least the specified threshold amounts, the GHGs are treated as subject to regulation and therefore as a regulated NSR pollutant from that source. (We call such a modification an "anyway modification.") In Tailoring Rule Step 2, beginning on July 1, 2011, and continuing thereafter, GHGs emitted by anyway sources and anyway modifications remain a regulated NSR pollutant in the same manner as under Step 1. In addition, for new sources that are not anyway sources and for modifications that are not anyway modifications, emissions of GHGs in at least specified threshold amounts are also treated as subject to regulation and therefore as a regulated NSR pollutant.

For GHGs, the Tailoring Rule does not change the basic PSD applicability process for evaluating whether there is a new major source or modification. However, due to the nature of GHGs and their incorporation into the definition of regulated NSR pollutant, the process for determining whether a source is emitting GHGs in an amount that would make the GHGs a regulated NSR pollutant, includes a calculation of, and applicability threshold for, the source based on CO_2 equivalent (CO_2e) emissions as well as its GHG mass emissions. Consequently, when determining the applicability of PSD to GHGs, there is a two-part applicability process that evaluates both:[27]

- the sum of the CO_2e emissions in TPY of the six GHGs, in order to determine whether the source's emissions are a regulated NSR pollutant; and, if so

- the sum of the mass emissions in TPY of the six GHGs, in order to determine if there is a major source or major modification of such emissions.

This applicability process is laid out in more detail in Sections II.B through D of this guidance, as well as in flowcharts in Appendices A through D.

CO_2e emissions are defined as the sum of the mass emissions of each individual GHG adjusted for its global warming potential (GWP). Since GWP values may vary, applicants should use the GWP values in Table A-1 of the Greenhouse Gas Reporting Program (GHGRP) (40 CFR Part 98, Subpart A, Table A-1). Note that the GHGRP does not require reporting of all emissions and emission sources that may be subject to a PSD applicability analysis.

[27] As we explained in the Tailoring Rule preamble, while evaluation of the mass-based thresholds is technically the second step in the PSD applicability analysis, we understand that most sources are likely to treat this mass-based evaluation as an initial screen from a practical standpoint, since they would not proceed to calculate emissions on a CO_2e basis if they do not trigger PSD or title V on a mass basis. See 75 FR at 31522.

In the annual US inventory of GHG emissions and sinks, EPA has reported that the Land-Use, Land-Use Change, and Forestry (LULUCF) sector (including those stationary sources using biomass for energy) in the United States is a net carbon sink, taking into account the carbon gains (*e.g.,* terrestrial sequestration) and losses (*e.g.,* emissions or harvesting) from that sector.[28] On the basis of the inventory results and other considerations, numerous stakeholders requested that EPA exclude, either partially or wholly, emissions of GHG from bioenergy and other biogenic sources for the purposes of the BACT analysis and the PSD program based on the view that the biomass used to produce bioenergy feedstocks can also be a carbon sink and, therefore, management of that biomass can play a role in reducing GHGs.[29] EPA plans to provide further guidance on how to consider the unique GHG attributes of biomass as fuel. Specifically, the EPA Administrator recently announced that EPA will complete a rulemaking by July 1, 2011 to defer for three years PSD applicability for biomass and other biogenic CO_2 emissions. The 3-year deferral will give EPA time to examine the science associated with biogenic CO_2 emissions and to consider the technical issues that the Agency must resolve in order to account for biogenic CO_2 emissions for PSD applicability purposes.[30] EPA published the proposed deferral rule on March 21, 2011 (76 FR 15249).

Before this rule becomes final, however, permitting authorities may consider, when carrying out their BACT analyses for GHG, the environmental, energy, and economic benefits that may accrue from the use of certain types of biomass and other biogenic sources (*e.g.,* biogas from landfills) for energy generation, consistent with existing air quality standards. In particular, a variety of federal and state policies have recognized that some types of biomass can be part of a national strategy to reduce dependence on fossil fuels and to reduce emissions of GHGs. Federal and state policies, along with a number of state and regional efforts, are currently under way to foster the expansion of renewable resources and promote biomass as a way of addressing climate change and enhancing forest-management. EPA believes that it is appropriate for permitting authorities to account for both existing federal and state policies and their underlying objectives in evaluating the environmental, energy, and economic benefits of biomass fuel. Based on these considerations, permitting authorities might determine that, with respect to the biomass component of a facility's fuel stream, certain types of biomass by themselves are BACT for GHGs.

To assist permitting authorities further in considering these factors, as well as to provide a measure of national consistency and certainty, in March 2011 EPA issued guidance that provides a suggested framework for undertaking an analysis of the environmental, energy, and economic benefits of biomass in Step 4 of the top-down BACT process, that, as a result, may enable permitting authorities to simplify and streamline BACT determinations with respect to certain types of biomass used in energy generation.[31] The guidance includes qualitative information on useful issues to consider with respect to biomass combustion. While the guidance does not provide a final determination of BACT for a particular source, since such determinations can only be made by individual permitting authorities on a case-by-case basis, EPA believes the

[28] 2010 US Inventory Report at http://epa.gov/climatechange/emissions/usinventoryreport.html.
[29] GHG emissions from bioenergy and other biogenic sources are generated during combustion or decomposition of biologically-based material, and include sources such as utilization of forest or agricultural products for energy, wastewater treatment and livestock management facilities, and fermentation processes for ethanol production.
[30] Letter from Lisa P. Jackson, EPA Administrator, to Senator Max Baucus (January 12, 2011).
[31] http://www.epa.gov/nsr/ghgdocs/bioenergyguidance.pdf

analysis provided in the guidance will be sufficient in most cases, during the interim period until the biomass deferral rulemaking is finalized and incorporated into applicable implementation plans to support the conclusion that utilization of biomass fuel alone is BACT for a bioenergy facility.

A. Calculating GHG Mass-Based and CO_2e-Based Emissions

For any source, since GHG emissions may be a mixture of up to six compounds, the amount of GHG emissions calculated for the PSD applicability analysis is a sum of the compounds emitted at the emissions unit. The following example illustrates the method to calculate GHG emissions on both a mass basis and CO_2e basis.

A proposed emissions unit emits five of the six GHG compounds in the following amounts:

50,000 TPY of CO_2
60 TPY of methane
1 TPY of nitrous oxide
5 TPY of HFC-32 (a hydrofluorocarbon)
3 TPY of PFC-14 (a perfluorocarbon)

The GWP for each of the GHGs used in this example are:

GHG	GWP*
Carbon Dioxide	1
Nitrous Oxide	310
Methane	21
HFC-32	650
PFC-14	6,500

** as of the date of this document (see 40 CFR Part 98, Subpart A, Table A-1)*

The ***GHGs mass-based emissions*** of the unit are calculated as follows:

50,000 TPY + 60 TPY + 1 TPY + 5 TPY + 3TPY = 50,069 TPY of GHGs

The ***CO_2e-based emissions*** of the unit are calculated as follows:

(50,000 TPY x 1) + (60 TPY x 21) + (1 TPY x 310) + (5 TPY x 650) + (3 TPY x 6,500)

= 50,000 + 1,260 + 310 + 3,250 + 19,500 = 74,320 TPY CO_2e

Note: Short tons (2,000 lbs), not long or metric tons, are used in PSD applicability calculations.[32]

[32] ~~Metric tonnes (*i.e.*, 1,000 kg) are~~ used in the GHG reporting rule.

B. PSD Applicability for GHGs - New Sources

1. *Tailoring Rule Step 1 - PSD Applicability Test for GHGs in PSD Permits Issued from January 2, 2011, to June 30, 2011*

PSD applies to the GHG emissions from a proposed new source if ***both*** of the following are true:[33]

- Not considering its emissions of GHGs, the new source is considered a major source for PSD applicability and is required to obtain a PSD permit (called an "anyway source"), ***and***

- The potential emissions of GHGs from the new source would be equal to or greater than 75,000 TPY on a CO_2e basis.

2. *Tailoring Rule Step 2 - PSD Applicability Test for GHGs in PSD Permits Issued on or after July 1, 2011*

PSD applies to the GHG emissions from a proposed new source if ***either*** of the following is true:

- PSD for GHGs would be required under Tailoring Rule Step 1, ***or***

- The potential emissions of GHGs from the new source would be equal to or greater than 100,000 TPY CO_2e basis ***and*** equal to or greater than the applicable major source threshold (*i.e.,* 100 or 250 TPY, depending on the source category[34]) on a mass basis for GHGs.

In addition, as noted in the Tailoring Rule, if a minor source construction permit is issued to a source before July 1, 2011, and that permit does not contain synthetic minor limitations on GHG emissions, and the source has a PTE of GHG emissions that would trigger PSD on or after July 1, 2011, then the source must either (1) begin actual construction before July 1, 2011, or (2) seek a permit revision to include a minor source limit for the GHG emissions. If neither (1) nor (2) occurs, the source must obtain a PSD permit for GHGs.[35]

The PSD applicability criteria discussed above for new sources are summarized in Table II-A below. Flowcharts for applicability determinations for new sources in each of the two Tailoring Rule steps are presented in Appendices A and B, respectively.

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[33] While the Tailoring Rule specified that potential emissions calculations for GHG applicability determinations would also involve a finding that potential emissions would be equal to or greater than the applicable significant emission rate on a mass basis, in the interest of clarity and simplicity, this guidance does not discuss this requirement with regard to new sources, because the lack of a netting analysis in a new source determination means that any new source that meets the 75,000 TPY CO_2e requirements would automatically exceed the applicable significant emissions rate for GHGs, which is 0 TPY on a mass basis.
[34] 42 USC 7479(1) (providing list of 100 TPY sources).
[35] 75 FR at 31527.

Table II-A. Summary of PSD Applicability Criteria for New Sources of GHGs

Permits issued from January 2, 2011, to June 30, 2011 (Step 1 of the Tailoring Rule)	Permits issued on or after July 1, 2011 (Step 2 of the Tailoring Rule)
PSD applies to GHGs, if: • The source is otherwise subject to PSD (for another regulated NSR pollutant), **and** • The source has a GHG PTE equal to or greater than: o 75,000 TPY CO_2e	**PSD applies to GHGs, if:** • The source is otherwise subject to PSD (for another regulated NSR pollutant), **and** • The source has a GHG PTE equal to or greater than: o 75,000 TPY CO_2e **OR** • Source has a GHG PTE equal to or greater than: o 100,000 TPY CO_2e, **and** o 100/250 TPY mass basis

C. PSD Applicability for GHGs - Modified Sources

1. General Requirements

a. *Tailoring Rule Step 1 - PSD Applicability Test for GHGs in PSD Permits Issued from January 2, 2011, to June 30, 2011*

PSD applies to the GHG emissions from a proposed modification to an existing major source if ***both*** of the following are true:

- Not considering its emissions of GHGs, the modification would be considered a major modification anyway and therefore would be required to obtain a PSD permit (called an "anyway modification"), ***and***

- The emissions increase ***and*** the **net** emissions increase of GHGs from the modification would be equal to or greater than 75,000 TPY on a CO_2e basis ***and*** greater than zero TPY on a mass basis.

b. *Tailoring Rule Step 2 - PSD Applicability Test for GHGs in PSD Permits Issued on or after July 1, 2011*

PSD applies to the GHG emissions from a proposed modification to an existing source if any of the following is true:

- PSD for GHGs would be required under Tailoring Rule Step 1.

OR BOTH:

- The existing source's PTE for GHGs is equal to or greater than 100,000 TPY on a CO_2e basis ***and*** is equal to or greater than 100/250 TPY (depending on the source category) on a mass basis,[36] ***and***

- The emissions increase ***and*** the **net** emissions increase of GHGs from the modification would be equal to or greater than 75,000 TPY on a CO_2e basis ***and*** greater than zero TPY on a mass basis.

OR BOTH:

- The existing source is minor[37] for PSD (including GHGs) before the modification, ***and***

- The actual or potential emissions of GHGs from the modification *alone* would be equal to or greater than 100,000 TPY on a CO_2e basis ***and*** equal to or greater than the applicable major source threshold of 100/250 TPY on a mass basis. Note that minor PSD sources cannot "net" out of PSD review.

The PSD applicability criteria for modified existing sources discussed above are summarized in Table II-B below. Flowcharts for applicability determinations for existing sources in each of the two Tailoring Rule steps are presented in Appendices C and D, respectively.

[36] The mass basis calculation for the amount of GHGs determines whether the GHGs are emitted at the major source level, so that GHGs are considered to be emitted at the major source level if they are emitted in an amount that is equals to or greater than 100/250 TPY (depending on the source category) on a mass basis. In contrast, the CO_2e basis calculation for the amount of GHGs is relevant for determining whether the GHGs are subject to regulation as a regulated NSR pollutant, but not for determining whether GHGs are emitted at the major source level.

[37] A source is considered minor for PSD if it does not emit any regulated NSR pollutants in amounts that equal or exceed 100/250 TPY (depending on the source category).

Table II-B. Summary PSD Applicability Criteria for Modified Sources of GHGs

Permits issued from January 2, 2011, to June 30, 2011 (Step 1 of the Tailoring Rule)	Permits issued on or after July 1, 2011 (Step 2 of the Tailoring Rule)
PSD applies to GHGs, if: • Modification is otherwise subject to PSD (for another regulated NSR pollutant), and has a GHG emissions increase and net emissions increase: o Equal to or greater than 75,000 TPY CO_2e, **and** o Greater than -0- TPY mass basis,	**PSD applies to GHGs, if:** • Modification is otherwise subject to PSD (for another regulated NSR pollutant), and has a GHG emissions increase and net emissions increase: o Equal to or greater than 75,000 TPY CO_2e, **and** o Greater than -0- TPY mass basis **OR BOTH:** • The existing source has a PTE equal to or greater than: o 100,000 TPY CO_2e **and** o 100/250 TPY mass basis • Modification has a GHG emissions increase and net emissions increase: o Equal to or greater than 75,000 TPY CO_2e, **and** o Greater than -0- TPY mass basis **OR BOTH:** • The source is an existing minor source for PSD, **and** • Modification alone has actual or potential GHG emissions equal to or greater than: o 100,000 TPY CO_2e, **and** o 100/250 TPY mass basis

2. Contemporaneous Netting

As noted above, assessing PSD applicability for a modification at an existing major stationary source against the GHG emissions thresholds is a two-step process. Step 1 of the applicability analysis considers only the emissions increases from the proposed modification itself. Step 2 of the applicability analysis, which is often referred to as "contemporaneous netting," considers all creditable emissions increases and decreases (including decreases resulting from the proposed modification) occurring at the source during the "contemporaneous period." The federal "contemporaneous period" for GHG emissions is no different than the federal contemporaneous period for other regulated NSR pollutants, which covers the period beginning 5 years before construction of the proposed modification through the date that the increase from the modification occurs.

It should be noted that both the contemporaneous period and the baseline period will, at least for a while, require reference to emissions prior to the January 2, 2011 date that PSD applies to GHG-emitting sources. That is, because the contemporaneous period includes a five-year "look back," for several years after January 2, 2011, the contemporaneous period for netting of GHG emissions includes periods before January 2, 2011. By the same token, when calculating the "baseline actual emissions" for existing units included in PSD applicability

calculations, the selected 24-month time period for determining actual emissions may include time periods that begin before January 2, 2011.

Because PSD applicability for modifications at existing sources requires a two-step analysis, and because, for GHGs, each step requires a mass-based calculation and a CO_2e-based calculation, a total of four applicability conditions must be met in order for modifications involving GHG emissions at existing major sources to be subject to PSD. These four conditions are summarized below.[38]

1) The CO_2e emissions increase resulting from the modification, calculated as the sum of the six GHGs on a CO_2e basis (*i.e.,* with GWPs applied) is equal to or greater than 75,000 TPY CO_2e. No emissions decreases are considered in this calculation (*i.e.,* if the sum of the change in the six GHGs on a CO_2e basis from an emissions unit included in the modification results in a negative number, that negative sum is not included in this calculation to offset increases at other emissions units).

2) The "net emissions increase" of CO_2e over the contemporaneous period is equal to or greater than 75,000 TPY.

3) The GHG emissions increase resulting from the modification, calculated as the sum of the six GHGs on a mass basis (*i.e.,* with no GWPs applied) is greater than zero TPY. No emissions decreases are considered in this calculation (*i.e.,* if the sum of the change in the six GHGs on a mass basis from an emissions unit included in the modification results in a negative number, that negative sum is not included in this calculation to offset increases at other emissions units).

4) The "net emissions increase" of GHGs (on a mass basis) over the contemporaneous period is greater than zero TPY.

Flowcharts of the above four-part PSD applicability test for modified sources of GHGs are presented in Appendices C and D. Appendix E provides a detailed example of the application of the test to a modified existing major source.

[38] In addition, as discussed above, either the modification must be an "anyway" modification or the source must emit, prior to the modification, GHGs in the amount of 100,000 TPY CO_2e and 100/250 TPY mass basis.

III. BACT Analysis

Under the CAA and applicable regulations, a PSD permit must contain emissions limitations based on application of BACT for each regulated NSR pollutant. A determination of BACT for GHGs should be conducted in the same manner as it is done for any other PSD regulated pollutant.

The BACT requirement is set forth in section 165(a)(4) of the CAA, in federal regulations at 40 CFR 52.21(j), in rules setting forth the requirements for approval of a state implementation plan (SIP) for a State PSD program at 40 CFR 51.166(j), and in the specific SIPs of the various states at 40 CFR Part 52, Subpart A - Subpart FFF. CAA § 169(3) defines BACT as:

> an emissions limitation (including a visible emission standard) based on the maximum degree of reduction for each pollutant subject to regulation under the Clean Air Act which would be emitted from any proposed major stationary source or major modification which the Administrator, 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….

Each new source or modified emission unit subject to PSD is required to undergo a BACT review.

The CAA and corresponding implementing regulations require that a permitting authority conduct a BACT analysis on a case-by-case basis, and the permitting authority must evaluate the amount of emissions reductions that each available emissions-reducing technology or technique would achieve, as well as the energy, environmental, economic and other costs associated with each technology or technique. Based on this assessment, the permitting authority must establish a numeric emissions limitation that reflects the maximum degree of reduction achievable for each pollutant subject to BACT through the application of the selected technology or technique. However, if the permitting authority determines that technical or economic limitations on the application of a measurement methodology would make a numerical emissions standard infeasible for one or more pollutants, it may establish design, equipment, work practices or operational standards to satisfy the BACT requirement.[39]

<u>Top-Down BACT Process</u>

EPA recommends that permitting authorities continue to use the Agency's five-step "top-down" BACT process to determine BACT for GHGs.[40] In brief, the top-down process calls for

[39] 40 CFR 51.166(b)(12); 40 CFR 52.21(b)(12).

[40] The Clean Air Act Advisory Committee (CAAAC) recognized that the top-down framework is the "predominant method for determining BACT" and recommended that permitting authorities continue to use their existing BACT determinations process, such as the top-down framework, in conducting BACT analyses for GHGs. CAAAC, *Interim Phase I Report of the Climate Change Work Group of the Permits, New Source Review and Toxics*

all available control technologies for a given pollutant to be identified and ranked in descending order of control effectiveness. The permit applicant should first examine the highest-ranked ("top") option. The top-ranked options should be established as BACT unless the permit applicant demonstrates to the satisfaction of the permitting authority that technical considerations, or energy, environmental, or economic impacts justify a conclusion that the top-ranked technology is not "achievable" in that case. If the most effective control strategy is eliminated in this fashion, then the next most effective alternative should be evaluated, and so on, until an option is selected as BACT.[41]

EPA has broken down this analytical process into the following five steps, which are each discussed in detail later in this section.

Step 1: Identify all available control technologies.

Step 2: Eliminate technically infeasible options.

Step 3: Rank remaining control technologies.

Step 4: Evaluate most effective controls and document results.

Step 5: Select the BACT.

To illustrate how the analysis proceeds through these steps, assume at Step 1 that the permit applicant and permitting authority identify four control strategies that may be applicable to the particular source under review. At the second step of the process, assume that one of these four options is demonstrated to be technically infeasible for the source and is eliminated from further consideration. The remaining three pollution control options should then be ranked from the most to the least effective at the third step of the process. In the fourth step, the permit applicant and permitting authority should begin by evaluating the energy, environmental, and economic impacts of the top-ranked option. If these considerations do not justify eliminating the top-ranked option, it should be selected as BACT at the fifth step. However, if the energy, environmental, or economic impacts of the top-ranked option demonstrate that this option is not achievable, then the evaluation remains in Step 4 of the process and continues with an examination of the energy, environmental, and economic impacts of the second-ranked option. This Step 4 assessment should continue until an achievable option is identified for each source. The highest-ranked option that cannot be eliminated is selected as BACT at Step 5, which includes the development of an emissions limitation that is achievable by the particular source using the selected control strategy. Thus, the inclusion and evaluation of an option as part of a top-down BACT analysis for a particular source does not necessarily mean that option will ultimately be required as BACT for that source.

Subcommittee (Feb. 3, 2010) at 16 and 18, *available at* http://www.epa.gov/oar/caaac/climate/2010_02_InterimPhaseIReport.pdf.

[41] 1990 Workshop Manual at B.2.

EPA developed the top-down process in order to improve the application of the BACT selection criteria and provide consistency.[42] For over 20 years, EPA has applied and recommended that permitting authorities apply the top-down approach to ensure compliance with the BACT criteria in the CAA and applicable regulations. EPA Regional Offices that implement the federal PSD program (through Federal Implementation Plans (FIPs)) and state permitting authorities that implement the federal program through a delegation of federal authority from an EPA Regional Office should apply the top-down BACT process in accordance with EPA policies and interpretations articulated in this document and others that are referenced. However, EPA has not established the top-down BACT process as a binding requirement through rule.[43] Thus, permitting authorities that implement an EPA-approved PSD permitting program contained in their State Implementation Plans (SIPs) may use another process for determining BACT in permits they issue, including BACT for GHGs, so long as that process (and each BACT determination made through that process) complies with the relevant statutory and regulatory requirements.[44] EPA does not require states to apply the top-down process in order to obtain EPA approval of a PSD program, but EPA regulations do require that each state program apply the applicable criteria in the definition of BACT.[45] Furthermore, EPA has certain oversight responsibilities with respect to the issuance of PSD permits under state permitting programs. In that capacity, EPA does not seek to substitute its judgment for state permitting authorities in BACT determinations, but EPA does seek to ensure that individual BACT determinations by states with approved programs are reasoned and faithful to the requirements of the CAA and the approved state program regulations.[46]

The discussion that follows in Section III provides an overview of the top-down BACT process, with discussion of how each step may apply to the aspects that are unique to GHGs. In addition, Appendices F, G, and H to this document provide illustrative examples of the application of the top-down BACT process to emissions of GHGs. These examples provide only basic illustrations of the concepts discussed in this document. A successful BACT analysis requires a more detailed record (that is, case- and fact-specific) to justify the conclusions reached by the permitting authority than can be provided in this guidance.

The most comprehensive discussion of the five-step top-down BACT process can be found in EPA's 1990 Draft New Source Review Workshop Manual ("1990 Workshop Manual"),[47] and the method has been progressively refined through federal permitting decisions by EPA, orders on title V permitting decisions, and opinions of the EPA Environmental Appeals Board (EAB) that have adopted many of the principles from the 1990 Workshop Manual and

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[42] Memorandum from Craig Potter, EPA Assistant Administrator for Air and Radiation, to Regional Administrators, *Improving New Source Review Implementation* (Dec. 1, 1987); Memorandum from John Calcagni, EPA Air Quality Management Division, *Transmittal of Background Statement on "Top-Down" Best Available Control Technology (BACT)* (June 13, 1989).

[43] *Alaska Department of Environmental Conservation v. EPA*, 124 S.Ct. 983, 995 n. 7 (2004).

[44] *In re Cardinal FG Company*, 12 E.A.D. 153, 162 (EAB 2005) and cases cited therein.

[45] 40 CFR 51.166(b)(12); 40 CFR 51.166(j).

[46] *Alaska Department of Environmental Conservation v. EPA*, 124 S.Ct. 983 (2004); *In the Matter of Cash Creek Generation, LLC*, Petition Nos. IV-2008-1 & IV-2008-2 (Order on Petition) (December 15, 2009).

[47] A copy of the 1990 Workshop Manual is available at http://www.epa.gov/ttn/nsr/gen/wkshpman.pdf. There is another draft version of the 1990 Workshop Manual that has jigsaw puzzle pieces on the cover, is not available online, and has some minor differences from the online version. For ease of reference, any citations to the 1990 Workshop Manual in this document refer to the version that is available at the link provided above.

expanded upon them. Thus, EPA recommends that permitting authorities seeking more detailed guidance on particular aspects of the top-down BACT process take care to consider more recent EPA actions (many of which are referenced in this document) in addition to the discussions in the 1990 Workshop Manual.[48]

Since the BACT provisions in the CAA and EPA's rules provide discretion to permitting authorities, a critical and essential component of a successful BACT analysis (whether it follows the top-down process or another approach) is the record supporting the decisions reached by the permitting authority. Permitting authorities should ensure that the BACT requirements contained in the final PSD permit are supported and justified by the information and analysis presented in a thorough and complete permit record. The record should clearly explain the reasons for selection or rejection of possible control and emissions reductions options and include appropriate supporting analysis.[49] In accordance with relevant statutory and regulatory requirements, the permitting authority must also provide notice of its preliminary decision on a source's application for a PSD permit and an opportunity for the public to comment on that preliminary decision. Thus, the record must also reflect careful consideration and response to each significant consideration raised in public comments. Each BACT analysis must be supported by a complete permitting record that shows consideration of all the relevant factors.

This guidance (including the appendices) provides some preliminary EPA views on some key issues that may arise in a BACT analysis for GHGs. It is important to recognize that this document does not provide any final determination of BACT for a particular source, since such determinations can only be made by individual permitting authorities on a case-by-case basis after consideration of the record in each case. Upon considering the record in an individual case, if a permitting authority has a reasoned basis to address particular issues discussed in this document in a different manner than EPA recommends here, permitting authorities (including EPA) have the discretion to do so in decisions on individual permit applications consistent with the relevant requirements in the CAA and regulations. Thus, depending on the relevant facts and circumstances, permitting authorities have the discretion to establish BACT limitations that are more or less stringent than levels that might appear to result if one were to follow the recommendations in this guidance.

Relationship of BACT and New Source Performance Standards (NSPS)

The CAA specifies that BACT cannot be less stringent than any applicable standard of performance under the New Source Performance Standards (NSPS).[50] As of the date of this guidance, EPA has not promulgated any NSPS that contain emissions limits for GHGs. EPA has developed this permitting guidance and associated technical "white papers"[51] to support initial

[48] See the collections of PSD guidance provided in footnote 2, *supra*.
[49] *In re Knauf Fiber Glass, GmbH*, 8 E.A.D. 121, 131 (EAB 1999) ("The BACT analysis is one of the most critical elements of the PSD permitting process. As such, it should be well documented in the administrative record."); *In re Steel Dynamics, Inc.*, 9 E.A.D. 165, 224-25 (EAB 2000) (remanding BACT limitation where permit issuer failed to provide adequate explanation for why limits deviated from those of other facilities).
[50] 42 USC 7479(3).
[51] These technical "white papers", targeting specific industrial sectors, provide basic information on GHG control options to assist states and local air pollution control agencies, tribal authorities and regulated entities implementing measures to reduce GHG, particularly in the assessment of best available control technology (BACT) under the PSD

BACT determinations for GHGs that will need to be made without the benefit of having an NSPS and supporting technical documents to inform the evaluation of the performance of available control systems and techniques.

To the extent EPA completes an NSPS for a relevant source category, BACT determinations that follow will need to consider the levels of the GHG standards and the supporting rationale for the NSPS. The process of developing NSPS and considering public input on proposed standards will advance the technical record on GHG control strategies and may reflect advances in control technology or reductions in the costs or other impacts of using particular control strategies. Thus, the guidance in this document should be viewed taking into consideration the potential development of an NSPS for a particular source category. In addition, the fact that a NSPS for a source category does not require a more stringent level of control does not preclude its consideration in a top-down BACT analysis.

Importance of Energy Efficiency

As discussed in greater detail below, EPA believes that it is important in BACT reviews for permitting authorities to consider options that improve the overall energy efficiency of the source or modification – through technologies, processes and practices at the emitting unit. In general, a more energy efficient technology burns less fuel than a less energy efficient technology on a per unit of output basis. For example, coal-fired boilers operating at supercritical steam conditions consume approximately 5 percent less fuel per megawatt hour produced than boilers operating at subcritical steam conditions.[52] Thus, considering the most energy efficient technologies in the BACT analysis helps reduce the products of combustion, which includes not only GHGs but other regulated NSR pollutants (*e.g.,* NO_X, SO_2, $PM/PM_{10}/PM_{2.5}$, CO, etc.). Thus, it is also important to emphasize that energy efficiency should be considered in BACT determinations for all regulated NSR pollutants (not just GHGs). Additional considerations concerning energy efficiency in the determination of BACT for GHGs are discussed in more detail below.

An available tool that is particularly useful when assessing energy efficiency opportunities and options is performance benchmarking. Performance benchmarking information, to the extent it is specific and relevant to the source in question, may provide useful information regarding energy efficient technologies and processes for consideration in the BACT assessment. Comparison of the unit's or source's energy performance with a benchmark may highlight the need to assess additional energy efficiency possibilities. To the extent that benchmarking an emissions unit or source shows it to be a poor-to-average performer, the permitting authority may need to document and evaluate whether greater efficiencies are achievable. To ensure that the source is constructed and operated in a manner consistent with achieving the energy efficiency goals determined to be BACT, consideration should be given to

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permitting program. These papers provide basic technical information that may be useful in a BACT analysis but they do not define BACT for each sector.

[52] U.S. Department of Energy, *Cost and Performance Baseline for Fossil Energy Plants - Volume 1: Bituminous Coal and Natural Gas to Electricity*, DOE/NETL-2007/1281, Final Report, Revision 1 (August 2007) at 6 (finding that the absolute efficiency difference between supercritical and subcritical boilers is 2.3% (39.1% compared to 36.8%), which is equivalent to a 5.9% reduction in fuel use), *available at* http://www.netl.doe.gov/energy-analyses/pubs/Bituminous%20Baseline_Final%20Report.pdf.

the individual and overall impact of the various measures under consideration. For example, in the case of numerous small energy saving measures, the intended effect of such measures could be reflected in projecting the GHG emissions limit or output-based standard for the emissions unit. On the other hand, it may be appropriate to include specific energy efficiency measures or techniques in the permit (as well as reflected in the GHG emissions limit) where such measures would clearly have a noticeable effect on energy savings.

There are a number of resources available for benchmarking facilities. For example, EPA's ENERGY STAR program for industrial sources offers several resources that can assist with performance benchmarking. To evaluate the energy performance of an entire facility,[53] ENERGY STAR developed sector-specific benchmarking tools called plant Energy Performance Indicators (EPIs).[54] For sectors where an EPI has been developed, these tools may be used to assess a plant's performance compared to the industry. At a unit and process level, ENERGY STAR has developed sector-specific Energy Guides for a number of industries. These Energy Guides discuss in detail processes and technologies that a permit applicant or permitting authority may wish to consider. This type of information may be particularly useful at the initial stages of the GHG BACT permitting process as the RACT/BACT/LAER clearinghouse (RBLC) is populated and updated with case-specific information.[55] Additional resources can be found in Appendix J of this document.

A. Determining the Scope of the BACT Analyses

General Concepts

An initial consideration that is not directly covered in the five steps of the top-down BACT process is the scope of the entity or equipment to which a top-down BACT analysis is applied. EPA has generally recommended that permit applicants and permitting authorities conduct a separate BACT analysis for each emissions unit[56] at a facility and has also encouraged applicants and permitting authorities to consider logical groupings of emissions units as appropriate on a case-by-case basis.[57]

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[53] For PSD applicability, the scope of the "major stationary source" is determined by the definition in 40 CFR 52.21(b)(1), and the title V "major source" is defined in 40 CFR 70.2. The PSD and title V regulations distinguish between a "facility" and a "stationary source"; in fact, the regulations include a facility as type of stationary source. 40 CFR 52.21(b)(5)-(6), 40 CFR 71.2. However, in this guidance, source and facility are used interchangeably to generally designate pollutant emitting structures and do not designate official positions regarding applicability unless otherwise noted.

[54] Current ENERGY STAR industrial sector EPIs can be found at http://www.energystar.gov/EPIS.

[55] The RBLC provides access to information and decisions about pollution control measures required by air pollution emission permits issued by state and local permitting agencies so that the information is accessible to all permitting authorities working on similar projects. The expanded RBLC includes GHG control and test data, and a GHG message board for permitting authorities.

[56] 40 CFR 52.21(b)(7).

[57] 1990 Workshop Manual at B.10; *In re General Motors, Inc.*, 10 E.A.D. 360, 382 (EAB 2002). EPA has also supported grouping emissions units in the similar context of evaluating options for meeting the technology-based LAER standards under the nonattainment NSR program. Memorandum from John Calcagni, Air Quality

For new sources triggering PSD review, the CAA and EPA rules provide discretion for permitting authorities to evaluate BACT on a facility-wide basis by taking into account operations and equipment which affect the environmental performance of the overall facility. The term "facility" and "source" used in applicable provisions of the CAA and EPA rules encompass the entire facility and are not limited to individual emissions units.[58]

For existing sources triggering PSD review, EPA rules are more explicit that BACT applies to those emission units at which a net emissions increase would occur at the source[59] as a result of a physical change or change in the method of operation.[60] EPA has interpreted these provisions to mean that BACT applies in the context of a modification to only an emissions unit that has been modified or added to an existing facility.[61]

GHG-Specific Considerations

The application of BACT to GHGs has the potential to place greater importance on determining the scope of the entity or equipment to which BACT applies. Under existing rules, a permitting authority evaluating applications to construct new sources has the flexibility to consider source-wide energy efficiency strategies (over an entire production process or across multiple production process) to reduce GHG emissions from the proposed new source. EPA interprets the language of the BACT definition in CAA §169, which requires consideration of "production processes and available methods, systems, and techniques ... for control of [each] pollutant," to include control methods that can be used facility-wide. As noted above, for a

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Management Division to David Kee, Region V, *Transfer of Technology in Determining Lowest Achievable Emissions Rate (LAER)* (Aug. 29, 1988).

[58] 42 USC 7479(1) and (3); 40 CFR 52.21(b)(1) and (5).

[59] For the purposes of determining whether a PSD permit is required (applicability of PSD), EPA requires a permitting authority to look beyond the emissions unit that is modified (across the entire source) to determine the extent of emissions increases that result from the modification. Thus, EPA has considered downstream and upstream emissions increases and decreases from emissions units that are not physically or operationally changed when determining the level of emissions increase that results from a modification. This concept is frequently described as "debottlenecking" because the upstream or downstream emission increases that are accounted for in the analysis are often the result of increased throughput across the source resulting from the removal of a bottleneck in the equipment that is physically changed. 1990 Workshop Manual at A.46; Letter from Kathleen Henry, Region III to John M. Daniel, Virginia DEQ (Oct. 23, 1998) (Intermet Archer Creek Facility). In 2006, EPA proposed potential changes to its approach to debottlenecking based on an analysis that the agency had flexibility to define the causation of an increase. 71 FR 54235 (Sept. 14, 2006). However, that proposal was not adopted by the Agency and explicitly withdrawn. The discussion of this concept in this note is intended solely to provide context for the BACT requirement. This note is in no way intended to modify the Agency's approach to this aspect of PSD applicability, as applied prior the 2006 proposal referenced above and continuing to this day.

[60] 40 CFR 52.21(j)(3).

[61] In the preamble for the 1980 rule that established the current version of 40 CFR 52.21(j)(3), EPA explained that "BACT applies only to the units actually modified." 45 FR 52676, 52681 (Aug. 7, 1980). Later in this preamble, EPA elaborated as follows with a specific example:

> The proposal required BACT for the new or modified emissions units which were associated with the modification and not for those unchanged emissions units at the same source. Thus, if an existing boiler at a source were modified or a new boiler added in such a way as to significantly increase particulate emissions, only that boiler would be subject to BACT, not the other emissions units at the source.

Id. at 52722. *See also* Letter from Robert Miller, EPA Region 5 to Lloyd Eagan, Wisconsin DNR (Feb. 8, 2000) (PSD applicability for debottlenecked source).

modification of an existing facility, EPA's existing regulations state that BACT only applies to emission units that are physically or operationally changed.[62]

EPA has historically interpreted the BACT requirement to be inapplicable to secondary emissions, which are defined to include emissions that may occur as a result of the construction or operation of a major stationary source but do not come from the source itself.[63] Thus, under this interpretation of EPA rules, a BACT analysis should not include (in Step 1 of the process) energy efficient options that may achieve reductions in a facility's demand for energy from the electric grid but that cannot be demonstrated to achieve reduction in emissions released from the stationary source (*e.g.,* within the property boundary). Nevertheless, as discussed in more detail below, EPA recommends that permitting authorities consider in a portion of the BACT analysis (Step 4) how available strategies for reducing GHG emissions from a stationary source may affect the level of GHG emissions from offsite locations.

B. BACT Step 1 – Identify All Available Control Options

General Concepts

The first step in the top-down BACT process is to identify all "available" control options. Available control options are those air pollution control technologies or techniques (including lower-emitting processes and practices) that have the potential for practical application to the emissions unit and the regulated pollutant under evaluation. To satisfy the statutory requirements of BACT, EPA believes that the applicant must focus on technologies that have been demonstrated to achieve the highest levels of control for the pollutant in question, regardless of the source type in which the demonstration has occurred.

Air pollution control technologies and techniques include the application of alternative production processes, methods, systems, and techniques, including clean fuels or treatment or innovative fuel combustion techniques for control of the affected pollutant. In some circumstances, inherently lower-polluting processes are appropriate for consideration as available control alternatives. The control options should include not only existing controls for the source category in question, but also controls determined through "technology transfer" that are applied to source categories with exhaust streams that are similar to the source category in question. The 1990 Workshop Manual provides useful guidelines for issues related to technology transfer among process applications. Primary factors that should be considered are the characteristics of the gas stream to be controlled, the comparability of the production processes (*e.g.,* batch versus continuous operation, frequency of process interruptions, special product quality concerns, etc.), and the potential impacts on other emission points within the source. Also, technologies in application outside the United States should be considered to the extent that the technologies have been successfully demonstrated in practice. In general, if a control option has been demonstrated in practice on a range of exhaust gases with similar physical and chemical characteristics and does not have a significant negative impact on process

[62] 40 CFR 52.21(j)(3).
[63] 44 FR 51924, 51947 (Sept. 5, 1979); 40 CFR 52.21(b)(18).

operations, product quality, or the control of other emissions, it may be considered as potentially feasible for application to another process.

Technologies that formed the basis for an applicable NSPS (if any) should, in most circumstances, be included in the analysis, as BACT cannot be set at an emission control level that is less stringent than that required by the NSPS.[64] In cases where a NSPS is proposed, the NSPS will not be controlling for BACT purposes since it is not a final action and the proposed standard may change, but the record of the proposed standard (including any significant public comments on EPA's evaluation) should be weighed when considering available control strategies and achievable emission levels for BACT determinations made that are completed before a final standard is set by EPA. However, even though a proposed NSPS is not a controlling floor for BACT, the NSPS is an independent requirement that will apply to an NSPS source that commences construction after an NSPS is proposed and carries with it a strong presumption as to what level of control is achievable. This is not intended to limit available options to only those considered in the development of the NSPS. For example, in addition to considering controls addressed in an NSPS rulemaking, controls selected in lowest achievable emission rate (LAER) determinations are available for BACT purposes, should be included as control alternatives included in BACT Step 1, and may frequently be found to represent the top control alternative at later steps in the BACT analysis.[65]

EPA has placed potentially applicable control alternatives identified and evaluated in the BACT analysis into the following three categories:

- ***Inherently Lower-Emitting Processes/Practices/Designs,***[66]
- ***Add-on Controls***, **and**
- ***Combinations of Inherently Lower Emitting Processes/Practices/Designs and Add-on Controls***.

The BACT analysis should consider potentially applicable control techniques from all of the above three categories. Lower-polluting processes (including design considerations) should be considered based on demonstrations made on the basis of manufacturing identical or similar products from identical or similar raw materials or fuels. Add-on controls, on the other hand, should be considered based on the physical and chemical characteristics of the pollutant-bearing emission stream.

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[64] 40 CFR 52.21(b)(12). While this guidance is being issued at a time when no NSPS have been established for GHGs, permitting authorities must consider any applicable NSPS as a controlling floor in determining BACT once any such standards are final.

[65] EPA has stated that technologies designated as meeting lowest achievable emission rate (LAER) – which are required in NSR permits issues to sources in non-attainment areas – are available for BACT purposes, must be included in the list of control alternatives in step 1, and will usually represent the top control alternative. 1990 Workshop Manual at B.5.

[66] While the 1990 Workshop Manual generally refers to "Inherently Lower Polluting Processes/Practices," the discussion contained in that portion of the Manual makes it clear that lower emitting *designs* may also be considered in Step 1 of the top-down analysis. See 1990 Workshop Manual at B.14 (stating that "the ability of design considerations to make the process inherently less polluting must be considered as a control alternative for the source").

As explained later in this guidance, in the course of the BACT analysis, one or more of the available options may be eliminated from consideration because they are demonstrated to be technically infeasible or have unacceptable energy, economic, and environmental impacts on a case- and fact-specific basis. However, such options should still be included in Step 1 of the BACT process, since the purpose of Step 1 of the process is to cast a wide net and identify all control options with potential application to the emissions unit under review that should be subject to scrutiny under later steps of the process.

While Step 1 is intended to capture a broad array of potential options for pollution control, this step of the process is not without limits. EPA has recognized that a Step 1 list of options need not necessarily include inherently lower polluting processes that would fundamentally redefine the nature of the source proposed by the permit applicant.[67] BACT should generally not be applied to regulate the applicant's purpose or objective for the proposed facility.

In assessing whether an option would fundamentally redefine a proposed source, EPA recommends that permitting authorities apply the analytical framework recently articulated by the Environmental Appeals Board.[68] Under this framework, a permitting authority should look first at the administrative record to see how the applicant defined its goal, objectives, purpose or basic design for the proposed facility in its application. The underlying record will be an essential component of a supportable BACT determination that a proposed control technology redefines the source.[69] The permitting authority should then take a "hard look" at the applicant's proposed design in order to discern which design elements are inherent for the applicant's purpose and which design elements may be changed to achieve pollutant emissions reductions without disrupting the applicant's basic business purpose for the proposed facility. In doing so, the permitting authority should keep in mind that BACT, in most cases, should not be applied to regulate the applicant's purpose or objective for the proposed facility.[70] This approach does not preclude a permitting authority from considering options that would change aspects (either minor or significant) of an applicants' proposed facility design in order to achieve pollutant reductions

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[67] *In re Prairie State Generating Company*, 13 E.A.D. 1, 23 (EAB 2006).

[68] *See, generally, In the Matter of American Electric Power Service Corporation, Southwest Electric Power Company, John W. Turk Plant*, Petition No. VI-2008-01 (Order on Petition) (December 15, 2009) (title V order referencing and applying framework developed by the EAB) ; *In the Matter of Cash Creek Generation, LLC*, Petition Nos. IV-2008-1 & IV-2008-2 (Order on Petition) (December 15, 2009) (same).

[69] *In re Desert Rock Energy Company*, PSD Appeal No. 08-03 et al. (EAB Sept. 24, 2009), slip op. at 65, 76.

[70] The EPA Environmental Appeals Board has applied this framework for evaluating redefining the source questions in three cases involving coal-fired power plants. *In re Desert Rock Energy Company*, PSD Appeal No. 08-03 et al. (EAB Sept. 24, 2009); *In re Northern Michigan University*, PSD Appeal No. 08-02 (EAB Feb. 18, 2009); *In re Prairie State Generating Company*, 13 E.A.D. 1 (EAB 2006). For additional examples of how EPA approached the redefining the source issue in the context of power plants prior to developing this analytical framework, see the following decisions. *In re Old Dominion Electric Cooperative*, 3 E.A.D. 779 (Adm'r 1992); *In re Hawaiian Commercial & Sugar Co.*, 4 E.A.D. 95 (EAB 1992); *In re SEI Birchwood Inc*., 5 E.A.D. 25 (EAB 1994). EPA also considered this issue in the context of waste incinerators prior to developing the recommended analytical framework. *In re Pennsauken*, 2 E.A.D. 667 (Adm'r 1988); *In the Matter of Spokane Regional Waste-to-Energy Facility*, 2 E.A.D. 809 (Adm'r 1989); *In the Matter of Brooklyn Navy Yard Resource Recovery Facility*, 3 E.A.D. 867 (EAB 1992); *In re Hillman Power Co., LLC*, 10 E.A.D. 673, 684 (EAB 2002). In another case, EPA considered this question in the context of a conversion of a natural-gas fired taconite ore facility to a petcoke fuel. *In re Hibbing Taconite Co*., 2 E.A.D. 838 (Adm'r 1989). For an example of the application of this concept to a fiberglass manufacturing facility, see *In re Knauf Fiber Glass*, 8 E.A.D 121 (EAB 1998).

that may or may not be deemed achievable after further evaluation at later steps of the process. EPA does not interpret the CAA to prohibit fundamentally redefining the source and has recognized that permitting authorities have the discretion to conduct a broader BACT analysis if they desire.[71] The "redefining the source" issue is ultimately a question of degree that is within the discretion of the permitting authority. However, any decision to exclude an option on "redefining the source" grounds must be explained and documented in the permit record, especially where such an option has been identified as significant in public comments.[72]

In circumstances where there are varying configurations for a particular type of source, the applicant should include in the application a discussion of the reasons why that particular configuration is necessary to achieve the fundamental business objective for the proposed construction project. The permitting authority should determine the applicant's basic or fundamental business purpose or objective based on the record in each individual case. For example, the permitting authority can consider the intended function of an electric generating facility as a baseload or peaking unit in assessing the fundamental business purpose of a permit applicant.[73] However, a factor that might be considered at later steps of the top-down BACT process, such as whether a process or technology can be applied on a specific type of source (Step 2) or the cost of constructing a source with particular characteristics (Step 4), should not be used as a justification for eliminating an option in Step 1 of the BACT analysis. Thus, cost savings and avoiding the risk of an apparently achievable technology transfer are not appropriately considered to be a part of the applicant's basic design or fundamental business purpose or objective.[74] Since BACT Step 4 also includes consideration of "energy" impacts from the control options under consideration, such impacts should not be used to justify excluding an option in Step 1 of a top-down BACT analysis.

The CAA includes "clean fuels" in the definition of BACT.[75] Thus, clean fuels which would reduce GHG emissions should be considered, but EPA has recognized that the initial list of control options for a BACT analysis does not need to include "clean fuel" options that would fundamentally redefine the source. Such options include those that would require a permit applicant to switch to a primary fuel type (*i.e.,* coal, natural gas, or biomass) other than the type of fuel that an applicant proposes to use for its primary combustion process. For example, when an applicant proposes to construct a coal-fired steam electric generating unit, EPA continues to believe that permitting authorities can show in most cases that the option of using natural gas as a primary fuel would fundamentally redefine a coal-fired electric generating unit.[76] Ultimately,

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[71] *In re Hawaiian Commercial & Sugar Co.*, 4 E.A.D. at 100; *In re Knauf Fiber Glass*, 8 E.A.D. at 136.
[72] *In re Desert Rock Energy Company*, slip op. at 70-71, 76-77; *In the Matter of Cash Creek Generation*, Order at 7-10.
[73] *In re Prairie State Generating Company*, 13 E.A.D. at 25 (recognizing distinction between sources designed to provide base load power and those designed to function as peaking facilities).
[74] *In re Prairie State Generating Company*, 13 E.A.D. at 23, n.23.
[75] 42 USC 7579(3). EPA has not yet updated the definition of BACT in the PSD regulations to reflect the addition of the "clean fuels" language that occurred in the 1990 amendments to the Clean Air Act. 40 CFR 52.21(b)(12); 40 CFR 51.166(b)(12). Nevertheless, EPA reads and applies its regulations consistent with the terms of the Clean Air Act.
[76] *See, e.g.,* 1990 Workshop Manual at B.13; *In re Old Dominion Electric Cooperative*, 3 E.A.D. at 793-94; *In re SEI Birchwood Inc*., 5 E.A.D. at 28, n. 8. *But see In re Hibbing Taconite Co.,* 2 E.A.D. 838, 843(Adm'r 1989) (finding it reasonable to consider burning natural gas instead of or in combination with coal where the plant at issue was already equipped to burn natural gas).

however, a permitting authority retains the discretion to conduct a broader BACT analysis and to consider changes in the primary fuel in Step 1 of the analysis. EPA does not classify the option of using a cleaner form of the same type of fuel that a permit applicant proposes to use as a change in primary fuel, so these types of options should be assessed in a top-down BACT analysis in most cases.[77] For example, a permitting authority may consider that some types of coal can have lower emissions of GHG than other forms of coal, and they may insist that the lower emitting coal be evaluated in the BACT review. Furthermore, when a permit applicant has incorporated a particular fuel into one aspect of the project design (such as startup or auxiliary applications), this suggests that a fuel is "available" to a permit applicant. In such circumstances, greater utilization of a fuel that the applicant is already proposing to use in some aspect of the project design should be listed as an option in Step 1 unless it can be demonstrated that such an option would disrupt the applicant's basic business purpose for the proposed facility.[78]

Although not required in Step 1 of the BACT process, the applicant may also evaluate and propose to apply innovative technologies that qualify for coverage under the innovative control technology waiver in EPA rules.[79] Under this waiver, a source is allowed an extended period of time to bring innovative technology into compliance with the required performance level. To be considered "innovative," a control technique must meet the provisions of 40 CFR 52.21(b)(19) or, where appropriate, the applicable definition in a state SIP. In the early 1990s, EPA did not consider it appropriate to grant applications for this waiver for proposed projects that were the same as or similar to projects for which the waiver had previously been granted.[80] However, in 1996, EPA said that it was inclined to allow additional waivers if the criteria in the CAA for such a waiver under the NSPS program were met. EPA proposed revisions to this provision in the PSD rules to incorporate the statutory criteria from the NSPS program, which specifies that such waivers may not exceed the number the administrator finds necessary to ascertain whether the criteria for issuing a waiver are met.[81] Though the 1996 proposal was never issued as final policy, EPA continues to adhere to the view expressed in that 1996 proposal and will consider approving more than one waiver under these conditions.

GHG-Specific Considerations

Permit applicants and permitting authorities should identify all "available" GHG control options that have the potential for practical application to the source under consideration. The application of BACT to GHGs does not affect the discretion of a permitting authority to exclude options that would fundamentally redefine a proposed source. GHG control technologies are

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[77] *See In re Old Dominion Electric Cooperative*, 3 E.A.D. at 793 (stating that the BACT analysis includes consideration of fuels cleaner than that proposed by the applicant); *In re Inter-Power of New York,* 5 E.A.D. 130, 145-150 (EAB 1994) (upholding permitting authorities BACT analysis involving coals with different sulfur contents). *But see In re Prairie State Generating Company*, 13 E.A.D. at 27-28 (finding the permitting authority properly excluded consideration of lower sulfur coal as redefining the source since the power plant at issue was co-located with a mine and designed to burn the coal from that mine) .

[78] *In the Matter of Cash Creek Generation*, Order at 7-10.

[79] 40 CFR 52.21(v); 40 CFR 51.166(s).

[80] 1990 Workshop Manual at B.13; Memo from Ed Lillis, Chief, Permits Program Branch, to Kenneth Eng, Chief, Air Compliance Branch, *Kamine Development Corporation's (KDC) Request for a Prevention of Significant Deterioration (PSD) Innovative Control Technology Waiver* (August 20, 1991).

[81] 61 FR 38250, 38281 (July 23, 1996).

likely to vary based on the type of facility, processes involved, and GHGs being addressed. The discussion below is focused on energy efficiency and carbon capture and storage (CCS) because these control approaches may be applicable to a wide range of facilities that emit large amounts of CO_2. Information on other technologies and mitigation approaches to control CO_2 as well as the other GHGs (*e.g.,* methane) is found in Appendix J.

The application of methods, systems, or techniques to increase energy efficiency is a key GHG-reducing opportunity that falls under the category of "lower-polluting processes/practices." Use of inherently lower-emitting technologies, including energy efficiency measures, represents an opportunity for GHG reductions in these BACT reviews. In some cases, a more energy efficient process or project design may be used effectively alone; whereas in other cases, an energy efficient measure may be used effectively in tandem with end-of-stack controls to achieve additional control of criteria pollutants. Applying the most energy efficient technologies at a source should in most cases translate into fewer overall emissions of all air pollutants per unit of energy produced. Selecting technologies, measures and options that are energy efficient translates not only in the reduction of emissions of the particular regulated NSR air pollutant undergoing BACT review, but it also may achieve collateral reductions of emissions of other pollutants, as well as GHGs.

For these reasons, EPA encourages permitting authorities to use the discretion available under the PSD program to include as available technologies in Step 1 the most energy efficient options in BACT analyses for both GHG and non-GHG regulated NSR pollutants. While energy efficiency can reduce emissions of all combustion-related emissions, it is a particularly important consideration for GHGs since the use of add-on controls to reduce GHG emissions is not as well-advanced as it is for most combustion-derived pollutants. Initially, in many instances energy efficient measures may serve as the foundation for a BACT analysis for GHGs, with add-on pollution control technology and other strategies added as they become more available. Energy efficient options that should be considered in Step 1 of a BACT analysis for GHGs can be classified in two categories.

The first category of energy efficiency improvement options includes technologies or processes that maximize the energy efficiency of the individual emissions unit. For example, the processes that may be used in electric generating facilities have varying levels of energy efficiency, measured in terms of amount of heat input that is used in the process or in terms of per unit of the amount of electricity that is produced. When a permit applicant proposes to construct a facility using a less efficient boiler design, such as a pulverized coal (PC) or circulating fluidized bed (CFB) boiler using subcritical steam pressure, a BACT analysis for this source should include more efficient options such as boilers with supercritical and ultra-supercritical steam pressures.[82] Furthermore, combined cycle combustion turbines, which generally have higher efficiencies than simple cycle turbines, should be listed as options when an applicant proposes to construct a natural gas-fired facility. In coal-fired permit applications,

[82] "Supercritical EGUs typically use steam pressures of 3,500 psi (24 MPa) and steam temperatures of 1,075°F (580°C). However, supercritical boilers can be designed to operate at steam pressures as high as 3,600 psi (25 MPa) and steam temperatures as high as 1,100°F (590°C). Above this temperature and pressure the steam is sometimes called 'ultra-supercritcal'[*sic*]." EPA Office of Air and Radiation, *Available and Emerging Technologies for Reducing Greenhouse Gas Emissions from Coal-fired Electric Generating Units* (October 2010) at 27.

EPA believes that integrated gasification combined cycle (IGCC) should also be listed for consideration when it is more efficient than the proposed technology.[83] However, these options may be evaluated under the redefining the source framework described above and excluded from consideration at Step 1 of a top-down analysis on a case-by-case basis if it can be shown that application of such a control strategy would disrupt the applicant's basic or fundamental business purpose for the proposed facility.

The second category of energy efficiency improvements includes options that could reduce emissions from a new greenfield facility by improving the utilization of thermal energy and electricity that is generated and used on site. As noted previously, BACT reviews for modified units at existing sources should focus on the emitting unit that is being physically or operationally changed. However, when reviewing a PSD permit application for the construction of a new facility that creates its own energy (thermal or electric) for its own use, EPA recommends that permitting authorities consider technologies or processes that not only maximize the energy efficiency of the individual emitting units, but also process improvements that impact the facility's energy utilization assuming it can be shown that efficiencies in energy use by the facility's higher-energy-using equipment, processes or operations could lead to reductions in emissions from the facility. EPA has long recognized that "a control option [considered in the BACT analysis] may be an 'add-on' air pollution control technology that removes pollutants from a facility's emissions stream, or an 'inherently lower-polluting process/practice' that prevents emissions from being generated in the first instance."[84]

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[83] EPA no longer subscribes to the reasoning used by the Agency in a 2005 letter to justify excluding IGCC from consideration in all cases on redefining the source grounds. Letter from Stephen Page, EPA OAQPS to Paul Plath, E3 Consulting, *Best Available Control Technology Requirements for Proposed Coal-Fired Power Plant Projects* (Dec. 13, 2005) (last paragraph on page 2). The Environmental Appeals Board subsequently rejected the application of this reasoning in an individual permit decision, where the record did not demonstrate that IGCC was inconsistent with the fundamental objectives of the permit applicant or distinguish between prior permit decisions that evaluated the technology in more detail. *In re Desert Rock Energy Company*, Slip. Op. at 68-69. Based on this decision, EPA also concluded that a state permit decision following substantially the same reasoning lacked a reasoned basis for excluding further consideration of IGCC. *In the Matter of: American Electric Power Service Corporation*, Order at 8-12. However, EPA continues to interpret the relevant provisions of the CAA, as described in the 2005 letter (pages 1-2), to provide discretion for permitting authorities to exclude options that would fundamentally redefine a proposed source, provided the record includes an appropriate justification in each case *In re Desert Rock Energy Company*, Slip. Op. at 76. Thus, IGCC should not be categorically excluded from a BACT analysis for a coal fired electric generating unit, and this technology should not be excluded on redefining the source grounds at Step 1 of a BACT analysis in any particular case unless the record clearly demonstrates why the permit applicant's basic or fundamental business purpose would be frustrated by application of this process.

[84] *In re Knauf Fiberglass, GMBH*, 8 EAD 121, 129 (EAB 1999) (citing 1990 NSR Workshop Manual at B.10, B.13). In *Knauf Fiberglass* the EPA's Environmental Appeals Board observed that "[t]he permitting authority may require consideration of alternative production processes in the BACT analysis when appropriate." *Id.* at 136. The EAB remanded a PSD permit for a facility that manufactured fiberglass insulation because of several deficiencies in the BACT analysis for the source. One of these deficiencies noted by the Board was the failure to sufficiently consider the possibility of applying an alternative process for producing the fiberglass that was used by another facility in the industry that had lower levels of PM10 emissions using the same add on controls. The source argued that it was unable to reduce its PM10 emissions to levels similar to its competitor because the competitor used a different production process that enabled it to achieve lower PM10 emissions levels. The EAB acknowledged that if the competitor's process was a proprietary trade secret, then such an option might be technically infeasible (not commercially available) for the source under evaluation, but called for the permit record to document this fact and for the applicant to seriously consider pollution control designs for other facilities that were a matter of public record. 8 EAD at 139-144. After the initial remand in 1999, the EAB later upheld a revised permit that was based

For example, an applicant proposing to build a new facility that will generate its own energy with a boiler could also consider ways to optimize the thermal efficiency of a new heat exchanger that uses the steam from the new boiler. Moreover, the design, operation, and maintenance of a steam distribution and utilization system may influence how much steam is needed to complete a specific task. If the steam distribution and utilization is optimized, less steam may be needed. In many cases, lower steam demand could result in lower fuel use and lower emissions at a new facility. Since lower-emitting processes should be considered in BACT reviews, opportunities to utilize energy more efficiently and therefore to produce less of it are appropriate considerations in a BACT review for a new facility. As discussed in the previous section, the evaluation of options in this second category can be facilitated by defining, in the case of new sources, the entity subject to BACT on a basis that encompasses the significant energy-using equipment, processes or operations of the facility.

For the first category of energy efficiency options described above, the number of options available for a given type of emissions unit at an existing or new source will generally be limited in number and not significantly expand the number of options that have traditionally been considered in BACT analyses for previously regulated NSR pollutants. However, the second category of options appropriate for consideration at a new greenfield facility may include equipment or processes that have the effect of lowering emissions because their efficient use of energy means that the facility's energy-producing emitting unit can produce less energy. Evaluation of options in this second category need not include an assessment of each and every conceivable improvement that could marginally improve the energy efficiency of the new facility as a whole (*e.g.,* installing more efficient light bulbs in the facility's cafeteria), since the burden of this level of review would likely outweigh any gain in emissions reduction achieved.[85] EPA instead recommends that the BACT analyses for units at a new facility concentrate on the energy efficiency of equipment that uses the largest amounts of energy, since energy efficient options for such units and equipment (*e.g.,* induced draft fans, electric water pumps) will have a larger impact on reducing the facility's emissions. EPA also recommends that permit applicants at new sources propose options that are defined as an overall category or suite of techniques to yield levels of energy utilization that could then be evaluated and judged by the permitting authority and the public against established benchmarks. Comparing the proposed suite of techniques to such benchmarks, which represent a high level of performance within an industry, would demonstrate that the new facility will achieve commensurate levels of energy efficiency using the proposed methods. Such an approach would leave some flexibility for the permit applicant to suggest the precise mix of measures that would meet the desired benchmark, and avoid including in a permit review an assessment of a large number of different combinations of technology choices for smaller pieces of equipment.

While engineering calculations and results from similar equipment demonstrations can often enable the permit applicant or engineer to closely estimate the energy efficiency of a unit,

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on the conclusion that it was not technically feasible for this source to use the lower-polluting process used by its competitor because the process was proprietary and not commercially available to Knauf. *In re Knauf Fiberglass, GMBH*, 9 EAD 1 (EAB 2000).

[85] One federal court has recognized the undesirability of making the BACT analysis into a "Sisyphean labor where there was always one more option to consider." *Sierra Club v. EPA*, 499 F.3d 653, 655 (7th Cir. 2007).

we recognize that, in some cases, it may be more difficult to fully and accurately predict the energy efficiency of a unit for BACT purposes. Commonly, the responsible design engineers or vendors will provide both estimated "expected" results and "guaranteed" results. Such estimates can be provided for the permitting authority's consideration. The difference between expected and guaranteed results gives some indication of the uncertainty and risk tolerances included in the guaranteed value. Still, in some cases, the ultimate energy efficiency of the unit may not be accurately known without testing the installed equipment, especially if multiple vendors or multiple design engineers are involved. Of course, this is substantially similar to many current permitting situations, such as when combustion enhancements are installed for controlling emissions of criteria pollutants and the exact effect on energy efficiency is somewhat uncertain until it is operationally tested. Thus, where there is some reasonable uncertainty regarding performance of specified energy efficiency measures, or the combination of measures, the permit can be written to acknowledge that uncertainty. As in the past, based on the particular circumstances addressed in the permitting record, the permitting authority has the discretion to set a permit limit informed by engineering estimates, or to set permit conditions that make allowance for adjustments of the BACT limits based on operational experience.

For the purposes of a BACT analysis for GHGs, EPA classifies CCS as an add-on pollution control technology[86] that is "available"[87] for facilities emitting CO_2 in large amounts, including fossil fuel-fired power plants, and for industrial facilities with high-purity CO_2 streams (*e.g.,* hydrogen production, ammonia production, natural gas processing, ethanol production, ethylene oxide production, cement production, and iron and steel manufacturing). For these types of facilities, CCS should be listed in Step 1 of a top-down BACT analysis for GHGs. This does not necessarily mean CCS should be selected as BACT for such sources. Many other case-specific factors, such as the technical feasibility and cost of CCS technology for the specific application, size of the facility, proposed location of the source, and availability and access to transportation and storage opportunities, should be assessed at later steps of a top-down BACT analysis. However, for these types of facilities and particularly for new facilities, CCS is an

[86] EPA recognizes that CCS systems may have some unique aspects that differentiate them from the types of equipment that have the traditionally been classified as add-on pollution controls (*i.e.,* scrubbers, fabric filters, electrostatic precipitators). However, since CCS systems have more similarities to such devices than inherently lower-polluting processes, EPA believes that CCS systems are best classified as add-on controls for purposes of a top-down BACT analysis.

[87] As noted above, a control option is "available" if it has a potential for practical application to the emissions unit and the regulated pollutant under evaluation. Thus, even technologies that are in the initial stages of full development and deployment for an industry, such as CCS, can be considered "available" as that term is used for the specific purposes of a BACT analysis under the PSD program. In 2010, the Interagency Task Force on Carbon Capture and Storage was established to develop a comprehensive and coordinated federal strategy to speed the commercial development and deployment of this clean coal technology. As part of its work, the Task Force prepared a report that summarizes the state of CCS and identified technical and non-technical challenges to implementation. EPA, which participated in the Interagency Task Force, supports the Task Force's recommendations concerning ongoing investment in demonstrations of the CCS technologies based on the report's conclusion that: "Current technologies could be used to capture CO_2 from new and existing fossil energy power plants; however, they are not ready for widespread implementation primarily because they have not been demonstrated at the scale necessary to establish confidence for power plant application. Since the CO_2 capture capacities used in current industrial processes are generally much smaller than the capacity required for the purposes of GHG emissions mitigation at a typical power plant, there is considerable uncertainty associated with capacities at volumes necessary for commercial deployment." See Report of the Interagency Task Force on Carbon Capture and Storage, p.50 (http://www.epa.gov/climatechange/policy/ccs_task_force.html).

option that merits initial consideration and, if the permitting authority eliminates this option at some later point in the top-down BACT process, the grounds for doing so should be reflected in the record with an appropriate level of detail.

In identifying control technologies in BACT Step 1, the applicant needs to survey the range of potentially available control options. EPA recognizes that dissemination of data and information detailing the function of the proposed control equipment or process is essential if permitting agencies are to reach consistent conclusions on the availability of GHG technology across industries. In the initial phase of PSD permit reviews for GHGs, background information about certain emission control strategies may be limited and technologies may still be under development. For example, alternative technologies are being developed for reusing carbon or sequestering carbon in a form or location other than through injection into underground formations. When these technologies are more developed, they could be included in Step 1 of the top-down BACT process. EPA will add information to the RBLC as it becomes available and supplement the information in the GHG Mitigation Measures Database.[88] EPA may also issue additional white papers for selected stationary source sectors in the future.

C. BACT Step 2 – Eliminate Technically Infeasible Options

General Concepts

Under the second step of the top-down BACT analysis, an available control technique listed in Step 1 may be eliminated from further consideration if it is not technically feasible for the specific source under review. A demonstration of technical infeasibility should be clearly documented and should show, based on physical, chemical, or engineering principles, that technical difficulties would preclude the successful use of the control option on the emissions unit under review.

EPA generally considers a technology to be technically feasible if it: (1) has been demonstrated and operated successfully on the same type of source under review, or (2) is available and applicable to the source type under review. If a technology has been operated on the same type of source, it is presumed to be technically feasible. An available technology from Step 1, however, cannot be eliminated as infeasible simply because it has not been used on the same type of source that is under review. If the technology has not been operated successfully on the type of source under review, then questions regarding "availability" and "applicability" to the particular source type under review should be considered in order for the technology to be eliminated as technically infeasible.[89]

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[88] EPA has developed a new online tool (GHG Mitigation Measures Database) that includes specific performance and cost data on current and developing GHG control measures. It also provides available data on other potential environmental impacts a GHG control measure may have. Currently, the database includes information on GHG controls for electric generating and cement production. This database can be found on EPA's website at http://www.epa.gov/nsr/ghgpermitting.html

[89] *In re Cardinal FG Company*, 12 E.A.D. 153, 166 (EAB 2005); *In re Steel Dynamics, Inc.*, 9 E.A.D. 165, 199 (EAB 2000).

In the context of a technical feasibility analysis, the terms "availability" and "applicability" relate to the use of technology in a situation that appears similar even if it has not been used in the same industry. Specifically, EPA considers a technology to be "available" where it can be obtained through commercial channels or is otherwise available within the common meaning of the term.[90] EPA considers an available technology to be "applicable" if it can reasonably be installed and operated on the source type under consideration. Where a control technology has been applied on one type of source, this is largely a question of the transferability of the technology to another source type. A control technique should remain under consideration if it has been applied to a pollutant-bearing gas stream with similar chemical and physical characteristics. The control technology would not be applicable if it can be shown that there are significant differences that preclude the successful operation of the control device. For example, the temperature, pressure, pollutant concentration, or volume of the gas stream to be controlled, may differ so significantly from previous applications that it is uncertain the control device will work in the situation currently undergoing review.

Evaluations of technical feasibility should consider all characteristics of a technology option, including its development stage, commercial applications, scope of installations, and performance data. The applicant is responsible for providing evidence that an available control measure is technically infeasible. However, the permitting authority is responsible for deciding technical feasibility. The permitting authority may require the applicant to address the availability and applicability of a new or emerging technology based on information that becomes available during the consideration of the permit application.

Information regarding what vendors will guarantee should be considered in the BACT selection process with all the other relevant factors, such as BACT emission rates for other recently permitted sources, projected cost and effectiveness of controls, and experience with the technology on similar gas streams. Commercial guarantees are a contract between the permit applicant and the vendor to establish the risk of non-performance the vendor is willing to accept, and they typically establish the remedy for failure to perform and the test methods for acceptance. A permit applicant uses these guarantees to provide its investors and lenders with reasonable assurances that the proposed facility will reliably perform its intended function and consistently meet the proposed permit limits. While permit applicants use these guarantees as protection from overly optimistic vendor claims for new technologies, experience demonstrates that these terms and conditions can also be customized for each circumstance to imply greater or lesser performance, depending on the stringency of the guarantees and associated penalties for nonperformance. The willingness of vendors to provide guarantees and the limits of these guarantees can be an important factor in determining the level of performance specified in a PSD permit. A vendor guarantee of a certain level of performance may be considered by the permitting authority later in the BACT process when proposing a specific emissions limit or level of performance in the PSD permit. However, a control technology should not be eliminated in Step 2 of the top-down BACT process based solely on the inability to obtain a commercial guarantee from a vendor on the application of technology to a source type.

[90] *In re Cardinal FG Company*, 12 E.A.D. at 14; *In re Steel Dynamics, Inc.*, 9 E.A.D. at 199.

Further, a technology should not be eliminated as technically infeasible due to costs. Where the resolution of technical difficulties is a matter of cost, this analysis should occur in BACT Step 4.

GHG-Specific Considerations

EPA's historic approach to assessing technical feasibility that is summarized above and described in the 1990 Workshop Manual and subsequent actions such as EAB decisions is generally applicable to GHGs. The nature of the concerns and remedies arising from identification of available technologies is well-explained in the 1990 Workshop Manual and other referenced documents. However, technologies available for controlling traditional pollutants were, in many cases, well-developed at the time that the 1990 Workshop Manual was drafted. Similarly, we expect the commercial availability of different GHG controls to increase in the coming years. Permitting authorities need to make sure that their decisions regarding technical infeasibility are well-explained and supported in their permitting record, paying particular attention to the most recent information from the commercial sector and other recently-issued permits.

This guidance is being issued at a time when add-on control technologies for certain GHGs or emissions sources may be limited in number and in various stages of development and commercialization. A number of ongoing research, development, and demonstration programs may make CCS technologies more widely applicable in the future.[91] These facts are important to BACT Step 2, wherein technically infeasible control options are eliminated from further consideration. When considering the guidance provided below, permitting authorities should be aware of the changing status of various control options for GHG emissions when determining BACT.

In the early years of GHG control strategies, consideration of commercial guarantees is likely to be involved in the BACT determination process. This type of guarantee may be more relevant for certain GHG controls because, unlike other pollutants with available, proven control technologies, some GHG controls may have a greater uncertainty regarding their expected performance. As noted above, the lack of availability of a commercial guarantee, by itself, is not a sufficient basis to classify a technology as "technologically infeasible" for BACT evaluation purposes, even for GHG control determinations.

As discussed earlier, although CCS is not in widespread use at this time, EPA generally considers CCS to be an "available" add-on pollution control technology for facilities emitting CO_2 in large amounts and industrial facilities with high-purity CO_2 streams. Assuming CCS has been included in Step 1 of the top-down BACT process for such sources, it now must be evaluated for technical feasibility in Step 2. CCS is composed of three main components: CO_2 capture and/or compression, transport, and storage. CCS may be eliminated from a BACT analysis in Step 2 if it can be shown that there are significant differences pertinent to the successful operation for each of these three main components from what has already been applied to a differing source type. For example, the temperature, pressure, pollutant

[91] For example, the U.S. Department of Energy has a robust CCS research, development, and demonstration program supported by annual appropriations and $3.4B of Recovery Act funds. See www.fe.doe.gov.

concentration, or volume of the gas stream to be controlled, may differ so significantly from previous applications that it is uncertain the control device will work in the situation currently undergoing review. Furthermore, CCS may be eliminated from a BACT analysis in Step 2 if the three components working together are deemed technically infeasible for the proposed source, taking into account the integration of the CCS components with the base facility and site-specific considerations (*e.g.,* space for CO_2 capture equipment at an existing facility, right-of-ways to build a pipeline or access to an existing pipeline, access to suitable geologic reservoirs for sequestration, or other storage options).

While CCS is a promising technology, EPA does not believe that at this time CCS will be a technically feasible BACT option in certain cases. As noted above, to establish that an option is technically infeasible, the permitting record should show that an available control option has neither been demonstrated in practice nor is available and applicable to the source type under review. EPA recognizes the significant logistical hurdles that the installation and operation of a CCS system presents and that sets it apart from other add-on controls that are typically used to reduce emissions of other regulated pollutants and already have an existing reasonably accessible infrastructure in place to address waste disposal and other offsite needs. Logistical hurdles for CCS may include obtaining contracts for offsite land acquisition (including the availability of land), the need for funding (including, for example, government subsidies), timing of available transportation infrastructure, and developing a site for secure long term storage. Not every source has the resources to overcome the offsite logistical barriers necessary to apply CCS technology to its operations, and smaller sources will likely be more constrained in this regard. Based on these considerations, a permitting authority may conclude that CCS is not applicable to a particular source, and consequently not technically feasible, even if the type of equipment needed to accomplish the compression, capture, and storage of GHGs are determined to be generally available from commercial vendors.

The level of detail supporting the justification for the removal of CCS in Step 2 will vary depending on the nature of the source under review and the opportunities for CO_2 transport and storage. As with all top-down BACT analyses, cost considerations should not be included in Step 2 of the analysis, but can be considered in Step 4. In circumstances where CO_2 transportation and sequestration opportunities already exist in the area where the source is, or will be, located, or in circumstances where other sources in the same source category have applied CCS in practice, the project would clearly warrant a comprehensive consideration of CCS. In these cases, a fairly detailed case-specific analysis would likely be needed to dismiss CCS. However, in cases where it is clear that there are significant and overwhelming technical (including logistical) issues associated with the application of CCS for the type of source under review (*e.g.,* sources that emit CO_2 in amounts just over the relevant GHG thresholds and produce a low purity CO_2 stream) a much less detailed justification may be appropriate and acceptable for the source. In addition, a permitting authority may make a determination to dismiss CCS for a small natural gas-fired package boiler, for example, on grounds that no reasonable opportunity exists for the capture and long-term storage or reuse of captured CO_2 given the nature of the project. That finding may be sufficient to dismiss CCS for similar units in subsequent BACT reviews, provided the facts upon which the original finding was made also apply to the subsequent units and are still valid.

D. BACT Step 3 – Ranking of Controls

General Concepts

After the list of all available controls is winnowed down to a list of the technically feasible control technologies in Step 2, Step 3 of the top-down BACT process calls for the remaining control technologies to be listed in order of overall control effectiveness for the regulated NSR pollutant under review. The most effective control alternative (*i.e.,* the option that achieves the lowest emissions level) should be listed at the top and the remaining technologies ranked in descending order of control effectiveness. The ranking of control options in Step 3 determines where to start the top-down BACT selection process in Step 4.[92]

In determining and ranking technologies based on control effectiveness, applicants and permitting authorities should include information on each technology's control efficiency (*e.g.,* percent pollutant removed, emissions per unit product), expected emission rate (*e.g.,* tons per year, pounds per hour, pounds per unit of product, pounds per unit of input, parts per million), and expected emissions reduction (*e.g.,* tons per year). The metrics chosen for ranking should best represent the array of control technology alternatives under consideration. While input-based metrics have traditionally been the preferred ranking format for many BACT analyses, for some source types, particularly combustion sources, it may be more appropriate to rank control options based on output-based metrics that would fully consider the thermal efficiency of the options when determining control effectiveness. In particular, where the output of the facility or the affected source is relatively homogeneous, an output-based standard (*e.g.,* pounds per megawatt hour of electricity, pounds per ton of cement, etc.) may best present the overall emissions control of an array of control options. Where appropriate, net output-based standards provide a direct measure of the energy efficiency of an operation's emission-reducing efforts. However, in the simple case of a new or modified fuel-fired unit, the thermal efficiency of the unit can be a useful ranking metric. Furthermore, when the output of the facility is a changing mix of products, an output-based standard may not be appropriate.

GHG-Specific Considerations

As discussed in earlier sections, the options considered in a BACT analysis for GHG emissions will likely include, but not necessarily be limited to, control options that result in energy efficiency measures to achieve the lowest possible emission level. Where plant-wide measures to reduce emissions are being considered as GHG control techniques, the concept of overall control effectiveness will need to be refined to ensure the suite of measures with the lowest net emissions from the facility is the top-ranked measure. Ranking control options based on their net output-based emissions ensures that the thermal efficiency of the control option, as well as the power demand of that control measure, is fully considered when comparing options in Step 3 of the BACT analysis.

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[92] EPA has previously recommended that Step 3 of a BACT analysis include an assessment of the energy, environmental, and economic impacts of each remaining option on the list. See 1990 Workshop Manual at B.25. However, the energy, environmental, and economic impacts of the control options are not actually compared until Step 4 of the process. See 1990 Workshop Manual at B.26. Thus, the compilation of this information can be accomplished in either Step 3 or Step 4 of the process.

Finally, to best reflect the impact on the environment, the ranking of control options should be based on the total CO_2e rather than total mass or mass for the individual GHGs. As explained in the Tailoring Rule, the CO_2e metric will "enable the implementation of flexible approaches to design and implement mitigation and control strategies that look across all six of the constituent gases comprising the air pollutant (*e.g.,* flexibility to account for the benefits of certain CH_4 control options, even though those options may increase CO_2).[93]

E. BACT Step 4 – Economic, Energy, and Environmental Impacts

General Concepts

Under Step 4 of the top-down BACT analysis, permitting authorities must consider the economic, energy, and environmental impacts arising from each option remaining under consideration. Accordingly, after all available and technically feasible control options have been ranked in terms of control effectiveness (BACT Step 3), the permitting authority should consider any specific energy, environmental, and economic impacts identified with those technologies to either confirm that the top control alternative is appropriate or determine it to be inappropriate. The "top" control option should be established as BACT unless the applicant demonstrates, and the permitting authority agrees, that the energy, environmental, or economic impacts justify a conclusion that the most stringent technology is not "achievable" in that case. If the most stringent technology is eliminated in this fashion, then the next most stringent alternative is considered, and so on.

In BACT Step 4, the applicant and permitting authority should consider both direct and indirect impacts of the emissions control option or strategy being evaluated. EPA has previously referred to BACT Step 4 as the "collateral impacts analysis,"[94] but this term is primarily applicable only to the environmental impact analysis. Overall, the Step 4 analysis is more accurately described as an environmental, economic, and energy impacts analysis that includes both direct and indirect (*i.e.,* collateral) considerations.

The economic impacts component of the analysis should focus on direct economic impacts calculated in terms of cost effectiveness (dollars per ton of pollutant emission reduced). Cost effectiveness should be addressed on both an average basis for each measure and combination of measures, and on an incremental basis comparing the costs and emissions performance level of a control option to the cost and performance of the next most stringent control option.[95] The emphasis should be on the cost of control relative to the amount of pollutant removed, rather than economic parameters that provide an indication of the general affordability of the control alternative relative to the source. To justify elimination of an option on economic grounds, the permit applicant should demonstrate that the costs of pollutant

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[93] 75 FR at 31531-2.
[94] *In re Hillman Power,* 10 E.A.D. at 683; *In the Matter of Columbia Gulf Transmission Co*., 2 E.A.D. 824, 828 n. 5 (Adm'r 1989); *In re Kawaihae Cogeneration Project*, 7 E.A.D. 107, 116-17 (EAB 1997).
[95] 1990 Workshop Manual, Section IV.D.2.b (B.36 – B.44).

removal for that option are disproportionately high.[96] Appendix K provides further direction on determining and considering cost effectiveness of control options. As noted in Appendix K, cost estimates used in BACT are typically accurate to within ± 20 to 30 percent.

EPA has traditionally called for the energy impacts analysis to consider only direct energy consumption and not indirect energy impacts, such as the energy required to produce raw materials for construction of control equipment.[97] Direct energy consumption impacts include the consumption of fuel and the consumption of electrical or thermal energy. This energy impacts analysis should include an assessment of demand for both electricity that is generated onsite and power obtained from the electrical grid, and may include an evaluation of impacts on fuel scarcity or a locally desired fuel mix in a particular area. Applicants and permitting authorities should examine whether the energy requirements for each control option result in any significant or unusual energy penalties or benefits.[98] The costs associated with direct energy impacts should be calculated and included in the economic impacts analysis (*i.e.,* cost analysis).[99]

Since a BACT limitation must reflect the maximum degree of reduction achievable for each regulated pollutant, the environmental impacts analysis in Step 4 should concentrate on impacts other than direct impacts due to emissions of the regulated pollutant in question. EPA has previously recommended focusing the BACT environmental impacts analysis in this manner to avoid confusion with the separate air quality impact analysis required under the CAA and PSD regulations for primarily the pollutants that are covered by NAAQS.[100] However, focusing Step 4 of the BACT analysis on increases in emissions of pollutants other than those the technology was designed to control is also justified because the essential purpose of BACT requirement is to achieve the maximum degree of reduction of the particular pollutant under evaluation. In this context, it is generally unnecessary to explicitly consider or justify the environmental benefits of reducing the pollutant subject to the BACT analysis, since these benefits are presumed under the CAA's mandate to reduce emissions of each regulated pollutant to the maximum degree achievable, considering energy, environmental, and economic impacts. Thus, in this context, it is reasonable to interpret the "environmental impact" component of the BACT requirement to focus on the indirect or collateral environmental impacts that may result from selection of control options that achieve the maximum degree of reduction for the pollutant under evaluation.

EPA has recognized that consideration of a wide variety of environmental impacts is appropriate in BACT Step 4, such as solid or hazardous waste generation, discharges of polluted water from a control device, visibility impacts, demand on local water resources, and emissions of other pollutants subject to NSR or pollutants not regulated under NSR such as air toxics.[101] EPA has also recognized that the environmental impacts analysis may examine trade-offs

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[96] 1990 Workshop Manual at B.31-32.
[97] *In re Power Holdings*, PSD Appeal No. 09-04 (EAB Aug. 13, 2010), slip op. at 22, n.17 (citing 1990 Workshop Manual at B.30).
[98] 1990 Workshop Manual at B.29.
[99] 1990 Workshop Manual at B.30.
[100] 1990 Workshop Manual at B.46.
[101] 1990 Workshop Manual at B.46; *In the Matter of North County Resource Recovery Assoc.*, 2 E.A.D. 229, 230 (Adm'r 1986).; *In the Matter of Columbia Gulf Transmission Co.*, 2 E.A.D. at 828.

between emissions of various pollutants resulting from the application of a specific control technique.[102] For instance, in selecting the BACT limit for carbon monoxide (CO) for a facility in an area that is nonattainment for ozone, a permitting authority may need to assess whether it is more important to select a less stringent control for CO emissions to avoid an unacceptable increase in NO_X emissions associated with the CO control technology. EPA has generally not attempted to place specific limits on the scope of the Step 4 environmental impacts analysis, but has focused on "any significant or unusual environmental impacts."[103]

To date, the environmental impacts analysis has not been a pivotal consideration when making BACT determinations in most cases.[104] Typically, applicants and permitting authorities focus on direct economic impacts (*i.e.,* cost effectiveness as measured in annualized cost per tons of pollutant removed by that control) as the reason for not selecting the top-ranked control option as BACT; however, there have been instances where environmental impacts have been a deciding factor in selecting a specific control technology as BACT (*i.e.,* water usage for scrubbers).[105]

Because the Step 4 impacts analysis is intended to help the permitting authority identify and weigh the various beneficial and detrimental impacts of the emissions control option or strategy being evaluated, EPA has recognized that permitting authorities have flexibility in deciding how to weigh the trade-offs associated with emissions control options. However, inherent with the flexibility is the responsibility of the permitting authority to develop a full permit record that explains those decisions given the specific facts of the facility at issue.[106]

GHG-Specific Considerations

There are compelling public health and welfare reasons for BACT to require all GHG reductions that are achievable, considering economic impacts and the other listed statutory factors. As a key step in the process of making GHGs a regulated pollutant, EPA has considered scientific literature on impacts of GHG emissions and has made a final determination that emissions of six GHGs endanger both the public health and the public welfare of current and future generations.[107] Among the public health impacts and risks that EPA cited are anticipated increases in ambient ozone and serious ozone-related health effects, increased likelihood of heat

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[102] 1990 Workshop Manual at B.49.
[103] *In re Hillman Power* 10 E.A.D. at 684 (internal quotations omitted).
[104] 1990 Workshop Manual at B.49-50; *In the Matter of Columbia Gulf Transmission Co.*, 2 E.A.D. at 828; *In re Hillman Power*, 10 E.A.D. at 688; *In re Kawaihae Cogeneration*, 7 E.A.D. at 117.
[105] Wyoming Dept. of Environmental Quality, Basin Electric Power Cooperative – Dry Fork Station, Permit Application Analysis NSR-AP-3546 (Feb. 5, 2007) at 11 (selecting a dry scrubber as BACT based, in part, on the "negative environmental impact" of the higher water use associated with the wet scrubber); *cf. In re Kawaihae Cogeneration Project*, 7 E.A.D. at 114-119 (upholding permitting decision in which the permitting authority considered the environmental impacts of ammonia used for SCR technology but found the increase in ammonia emissions were not significant enough to warrant use of less stringent NOx control technology)
[106] 1990 Workshop Manual at B.8-9. *See also Alaska Dept. of Environmental Conservation v. EPA*, 540 U.S. 461, 485-495 (2004) (finding EPA has the authority to review state BACT decisions to determine whether they complied with the CAA and upholding EPA's right to issue stop construction orders upon finding a state permitting authority's BACT determination was unreasonable).
[107] *Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act; Final Rule*, 74 FR 66496, December 15, 2009.

waves affecting mortality and morbidity, risk of increased intensity of hurricanes and floods, and increased severity of coastal storm events due to rising sea levels. With respect to public welfare, EPA cited numerous and far-ranging risks to food production and agriculture, forestry, water resources, sea level rise and coastal areas, energy, infrastructure, and settlements, and ecosystems and wildlife. The potentially serious adverse impacts of extreme events such as wildfires, flooding, drought and extreme weather conditions also supported EPA's finding.

The energy, environmental, and economic impacts discussed in the section above should be considered for each GHG control technology when conducting a top-down analysis. In conducting the energy, environmental and economic impacts analysis, permitting authorities have "a great deal of discretion" in deciding the specific form of the BACT analysis and the weight to be given to the particular impacts under consideration.[108] EPA and other permitting authorities have most often used this analysis to eliminate more stringent control technologies with significant or unusual effects that are unacceptable in favor of the less stringent technologies with more acceptable collateral environmental effects. However, EPA has also interpreted the BACT requirements to allow for a more stringent technology to remain in consideration as BACT if the collateral environmental benefits of choosing such a technology outweigh the economic or energy costs of that selection.[109] In other words, the permitting authority is not limited to evaluating the impacts of only the "top" or most effective technology but can assess the impacts of all technologies under consideration.[110] The same principle applies when assessing technologies for controlling GHGs.

When conducting a BACT analysis for GHGs, the environmental impact analysis should continue to concentrate on impacts other than the direct impacts due to emissions of the regulated pollutant in question. Where GHG control strategies affect emissions of other regulated pollutants, applicants and permitting authorities should consider the potential trade-offs of selecting particular GHG control strategies. Likewise, when conducting a BACT analysis for other regulated NSR pollutants, applicants and permitting authorities should take care to consider how the control strategies under consideration may affect GHG emissions. For example, controlling volatile organic compound (VOC) emissions with a catalytic oxidation system creates GHG emissions in the form of CO_2. Permitting authorities have flexibility when evaluating the trade-offs associated with decreasing one pollutant at the cost of increasing another, and the specific considerations made will depend on the facts of the specific permit at issue. For options that involve improvements in the energy efficiency of a source, EPA does not expect there to be significant trade-offs in emissions of regulated pollutants since energy efficiency improvements should generally reduce emissions of all pollutants resulting from combustion processes.

When weighing any trade-offs between emissions of GHGs and emissions of other regulated NSR pollutants, EPA recommends that permitting authorities focus on the relative levels of GHG emissions rather than the endpoint impacts of GHGs. As a general matter, GHG emissions contribute to global warming and other climate changes that result in impacts on the environment and society. However, due to the global scope of the problem, climate change

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[108] *In re Hillman Power*, 10 E.A.D. at 684.
[109] *In the Matter of North County Resource Recovery Assoc.*, 2 E.A.D. at 230-31.
[110] *In re Knauf Fiber Glass,* 8 E.A.D. at 131 n. 15.

modeling and evaluations of risks and impacts of GHG emissions currently is typically conducted for changes in emissions orders of magnitude larger than the emissions from individual projects that might be analyzed in PSD permit reviews. Quantifying these exact impacts attributable to the specific GHG source obtaining a permit in specific places is not currently possible with climate change modeling. Given these considerations, an assessment of the potential increase or decrease in the overall level of GHG emissions from a source would serve as the more appropriate and credible metric for assessing the relative environmental impact of a given control strategy. Thus, when considering the trade-offs between the environmental impacts of a particular level of GHG reduction and a collateral increase in another regulated NSR pollutant, rather than attempting to determine or characterize specific environmental impacts from GHGs emitted at particular locations, EPA recommends that permitting authorities focus on the amount of GHG emission reductions that may be gained or lost by employing a particular control strategy and how that compares to the environmental or other impacts resulting from the collateral emissions increase of other regulated NSR pollutants.

In determining how to value or weigh any trade-offs in emissions for regulated pollutants (including GHGs), permitting authorities should continue to focus on "significant or unusual environmental impacts that have the potential to affect the selection or elimination of a control alternative."[111] Relatively small collateral increases of another pollutant need not be of concern, unless even that small increase would be significant, such as a situation where an area is close to exceeding a NAAQS or PSD increment and the additional increase could push the area into nonattainment. Thus, to assess the significance of an emissions increase or decrease, a permitting authority should give some consideration to the impacts of a given amount of emissions. However, permitting authorities need not consider every possible environmental endpoint impact of every conceivable technology. The top-down BACT process calls for evaluating only those control alternatives that remain under consideration at BACT Step 4 of the analysis. Thus, when a trade-off is present, permitting authorities may limit their consideration of environmental impacts to only to those control options in which the comparison of GHG emissions to other regulated NSR pollutants might actually lead to a different selection of BACT for that facility.

With respect to the evaluation of the economic impacts of GHG control strategies, 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. For instance, when evaluating the cost effectiveness of CCS as a GHG control option, if the cost of building a new pipeline to transport the CO_2 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 CO_2 capture system. As with all evaluations of economics, a permitting authority should explain its decisions in a well-documented permitting record.

EPA recognizes that at present CCS is an expensive technology, largely because of the costs associated with CO_2 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

[111] *In re Hillman Power,* 10 E.A.D. at 684.

Step 4 of the BACT analysis, even in some cases where underground storage of the captured CO_2 near the power plant is feasible. However, there may be cases at present where the economics of CCS are more favorable (for example, where the captured CO_2 could be readily sold for enhanced oil recovery), making CCS a more viable option under Step 4. In addition, as a result of the ongoing research and development described in the Interagency Task Force Report noted above, CCS may become less costly and warrant greater consideration in Step 4 of the BACT analysis in the future.

As in the past for criteria pollutant BACT determinations, the final decision regarding the reasonableness of calculated cost effectiveness values will be made by the permitting authority. This decision is typically made by considering previous regulatory and permitting decisions for similar sources. As noted above, to justify elimination of a control option on economic grounds, the permit applicant should demonstrate that the costs of pollutant removal for the particular option are disproportionately high. However, given that there is little history of BACT analyses for GHG at this time, 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. 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 RBLC. We note, however, that when looking at pollutants historically regulated under the PSD Program, such as criteria pollutants, the cost effectiveness of a control device is based on a significantly lower volume of emissions than the amount of emissions that are emitted by most sources of GHGs. For example, a new boiler that is subject to the NSPS and emits 250 TPY of NO_X will emit well above 100,000 TPY of CO_2e. As a result, even taking account of the current limited data and consequent uncertainty concerning the costs of GHG BACT, it is reasonable to anticipate that the cost effectiveness numbers (in \$/ton of CO_2e) for the control of GHGs will be significantly lower than those of the cost effectiveness values for controls of criteria pollutants that have evolved over time.[112]

With respect to energy impacts in a BACT analysis for GHGs, the relative energy demands of the options under consideration for reducing emissions from the facility obtaining a permit should be considered when weighing options for reducing direct emissions of GHGs in Step 4 of the analysis, regardless of the location where the thermal or electrical energy for the facility is produced. This analysis should include an assessment of how particular control options for GHGs may impact the amount of energy that must be produced at an offsite location to support the operation of the facility obtaining the permit. Given the potential emissions from generation of electricity, such impacts may also be considered in the context of environmental impacts.[113]

Permitting authorities also have flexibility when evaluating the trade-offs between energy, environmental, and economic impacts. In selecting a technology for GHG control, a

[112] For consistency purposes, cost effectiveness for GHG control options should be based on dollars per ton of CO_2e removed, rather than total mass or mass for the individual GHGs.

[113] As discussed above in the section on Step 1, energy efficiency improvements that only function to reduce the secondary emissions associated with offsite combustion to produce energy at another location should not be considered as options in the BACT analysis under existing EPA interpretations of its regulations.

permitting authority may find that while a control option with high overall energy efficiency has higher economic costs, those costs are outweighed by the overall reduction of emissions of all pollutants that comes from that higher efficiency. There are no "right" answers to these permitting decisions that can be described in this general guidance, because permitting authorities have a wide range of discretion in their consideration of the various direct and indirect economic, energy, and environmental impacts that might be informative to the top-down BACT analysis for GHG emissions, as well as the BACT determinations for other pollutants. Given the case-by-case nature of the BACT analysis and the importance of considering impacts on the local environment and community (*e.g.,* job loss and the potential movement of production overseas), EPA still believes this flexibility provided for deciding how best to weigh the trade-offs associated with a particular emissions control option continues to be appropriate when evaluating BACT for GHGs. The exact scope and detail of that consideration – including the final decision regarding various trade-offs that may arise in a permitting decision – is dependent on many factors, including the specific facts of the proposed facility, local interests and concerns, and the nature of issues raised in public comments. Accordingly, permitting authorities must ensure that their impacts analysis fully considers the relevant facts and concerns for the facility at issue and that the support for the environmental, economic, and energy choices made during the impacts analysis of the BACT determination is well-documented in the permit record. In so doing, we encourage permitting authorities to use their discretion to consider the full range of impacts from the various controls that could result in facilities that are energy efficient and that lower the overall impact of the GHG emissions from those facilities, while maintaining relatively high levels of controls of other pollutants.

F. BACT Step 5 – Selecting BACT

General Concepts

In Step 5 of the BACT determination process, the most effective control option not eliminated in Step 4 should be selected as BACT for the pollutant and emissions unit under review and included in the permit. During Step 3, permitting authorities often consider control alternatives that have a range of potential effectiveness for reducing the pollutant emissions at issue, and thus they must identify an expected emissions reduction range for each technology. In setting the BACT limit in Step 5, the permitting authority should look at the range of performance identified previously and determine a specific limit to include in the final permit. In determining the appropriate limit, the permitting authority can consider a range of factors, including the ability of the control option to consistently achieve a certain emissions rate, available data on past performance of the selected technology, and special circumstances at the specific source under review which might affect the range of performance.[114] In setting BACT limits, permitting authorities have the discretion to select limits that do not necessarily reflect the highest possible control efficiencies but that will allow compliance on a consistent basis based on the particular circumstances of the technology and facility at issue, and thus may consider safety factors unique to those circumstances in setting the limits.[115] EPA has also recognized that in

[114] *In re Prairie State Generating Company*, 13 E.A.D. at 67-71.
[115] *In re Prairie State Generating Company*, 13 E.A.D. at 71, 73 (and cases cited therein).

some circumstances, it may be acceptable to establish BACT limits that can be adjusted or optimized as the performance of a technology becomes clearer after a period of operation.[116]

The permitting authority is also responsible for defining the form of the BACT limits, and making them enforceable as a practical matter.[117] In determining the form of the limit, the permitting authority should consider issues such as averaging times and units of measurement. For example, a final permit may include a limit based on pounds of emissions on a 24-hour rolling average or a limit representing a percentage of pollutant per weight allowed in the fuel. When making sure the limit is practically enforceable, the permitting authority must include information regarding the methods that will be used for determining compliance with the limits (such as operational parameters, timing, testing methods, etc.) and ensure that there is no ambiguity in the permit terms themselves.[118]

Finally, the permitting authority bears the responsibility in Step 5 to fully justify the BACT decision in the permit record. Regardless of the control level proposed by the applicant as BACT, the ultimate determination of BACT is made by the permitting authority after public review is complete. The applicant's role is primarily to provide information on the various control options and, when it proposes a less stringent control option, provide a detailed rationale and supporting documentation for eliminating the more stringent options. It is the responsibility of the permitting authority to review the documentation and rationale presented in order to: (1) ensure that the applicant has addressed all of the most effective control options that could be applied and; (2) determine that the applicant has adequately demonstrated that energy, environmental, or economic impacts justify any proposal to eliminate the more effective control options. Where the permitting authority does not accept the basis for the proposed elimination of a control option, the permitting authority may inform the applicant of the need for more information regarding the control option. However, the BACT selection essentially should default to the highest level of control for which the applicant could not adequately justify its elimination based on energy, environmental and economic impacts. If the applicant is unable to provide to the permitting authority's satisfaction an adequate demonstration for one or more control alternatives, the permitting authority should proceed to establish BACT and prepare a draft permit based on the most effective control option for which an adequate justification for rejection was not provided.

GHG-Specific Considerations

We expect many permits issued after January 2, 2011, to initially place more of an emphasis on energy efficiency, given the role it plays in affecting emissions of GHGs. For energy producing sources, as noted above, one way to incorporate the energy efficiency of a process unit into the BACT analysis is to compare control effectiveness in BACT Step 3 based on output-based emissions of each of the control options. Even in cases where another metric is used in Step 3 to compare options, once an option is selected in Step 5, permitting authorities

[116] *In re AES Puerto Rico, L.P.*, 8 E.A.D. 324, 348-50 (EAB 1999), *In re Hadson Power 14-Buena Vista*, 4 E.A.D. 258, 291 (EAB 1992).
[117] *See generally* EPA Guidance on Limiting Potential to Emit (PTE) in New Source Permitting (June 13, 1989), *available at* http://www.epa.gov/reg3artd/permitting/t5_epa_guidance.htm.
[118] *In re Prairie State Generating Company*, 13 E.A.D. at 83, 120.

may consider converting the BACT emissions limit to a net output basis for the permitted emissions limit. EPA encourages permitting authorities to consider establishing an output-based BACT emissions limit, or a combination of output- and input-based limits, wherever feasible and appropriate to ensure that BACT is complied with at all levels of operation. Although developed as part of a voluntary program, EPA believes the draft handbook entitled *Output-Based Regulations: A Handbook for Air Regulators* (August 2004) may provide relevant information to assist permitting authorities in establishing limits based on output.[119] Furthermore, since the environmental concern with GHGs is with their cumulative impact in the environment, metrics should focus on longer-term averages (*e.g.,* 30- or 365-day rolling average) rather than short-term averages (*e.g.,* 3- or 24-hr rolling average).

In addition to a permit containing specific numerical emissions limits established in a BACT analysis, a permit can also include conditions requiring the use of a work practice such as an Environmental Management System (EMS) focused on energy efficiency as part of that BACT analysis. The ENERGY STAR program provides useful guidance on the elements of an energy management program. The inclusion of such a requirement would be appropriate where it is technically impractical to measure emissions and/or energy use from all of the equipment and processes of the plant and apply an output-based standard to each of them. For example, a candidate might be a factory with many different pieces of equipment and processes that use energy. In addition to a BACT emissions limit on the boiler providing energy, the permit could also lay out a requirement to implement an EMS along with a requirement that all suggested actions that result in net savings have to be implemented. Consequently, the plant will operate in the most efficient manner through gradual achievable improvements. However, design, equipment, or work practice standards may not be used in lieu of a numerical emissions limitation(s) unless there is a demonstration in the record that the criteria for applying such a standard are satisfied.

[119] *Output-Based Regulations: A Handbook for Air Regulators* (Draft Final Report) (August 2004), *available at* http://www.epa.gov/chp/documents/obr_final_9105.pdf.

IV. Other PSD Requirements

General Concepts

The PSD requirements include several provisions requiring new and modified major stationary sources to conduct air quality analyses that may involve air quality modeling and ambient monitoring. The applicant must demonstrate that the emissions of any regulated NSR pollutant do not cause or contribute to a violation of any NAAQS or PSD increments.[120] Several months of ambient air quality data must also be collected in some circumstances to support this analysis.[121] In addition, as part of the "additional impacts analysis," the applicant must provide an analysis of the air quality impact of the source or modification, including an analysis of the impairment to visibility, soils, and vegetation (but not vegetation with no significant commercial or recreational value) that would occur as a result of the source or modification and general commercial, residential, industrial, and other growth associated with the source or modification.[122] Under the federal PSD rules, this analysis may also include monitoring of visibility in any Federal Class I area near the source or modification "for such purposes and by such means as the Administrator deems necessary and appropriate."[123] A demonstration must be made that emissions will not cause or contribute to a violation of any Class I increment and will not have an adverse impact on any air quality related value (AQRV), as defined by the Federal Land Manager, in such area.[124] Under PSD, if a source's proposed project may impact a Class I area, the Federal Land Manager must be notified so this office may fulfill its responsibility for evaluating a source's projected impact on the AQRVs and recommending either approval or disapproval of the source's permit application based on anticipated impacts.

GHG-Specific Considerations

The Tailoring Rule includes the following statement with respect to these requirements:

> "There are currently no NAAQS or PSD increments established for GHGs, and therefore these PSD requirements would not apply for GHGs, even when PSD is triggered for GHGs. However, if PSD is triggered for a GHG emissions source, all regulated NSR pollutants which the new source emits in significant amounts would be subject to PSD requirements. Therefore, if a facility triggers review for regulated NSR pollutants that are non-GHG pollutants for which there are established NAAQS or increments, the air quality, additional impacts, and Class I requirements would apply to those pollutants."[125]

Since there are no NAAQS or PSD increments for GHGs,[126] the requirements in sections 52.21(k) and 51.166(k) of EPA's regulations to demonstrate that a source does not cause or

[120] 42 USC 7475(a)(3); 40 CFR 52.21(k); 40 CFR 51.166(k).
[121] 40 CFR 52.21(m); 40 CFR 51.166(m); 40 CFR 52.21(i)(5); 40 CFR 51.166(i)(5).
[122] 40 CFR 52.21(o); 40 CFR 51.166(o).
[123] 40 CFR 52.21(o)(3).
[124] 40 CFR 52.21(p); 40 CFR 51.166(p).
[125] 75 FR at 31520.
[126] In addition, GHGS have not been designated as a precursor for any criteria pollutant under section 302(g) of the Clean Air Act or in EPA's PSD rules.

contribute to a violation of the NAAQS is not applicable to GHGs. Thus, we do not recommend that PSD applicants be required to model or conduct ambient monitoring for CO_2 or GHGs.

Monitoring for GHGs is not required because EPA regulations provide an exemption in sections 52.21(i)(5)(iii) and 51.166(i)(5)(iii) for pollutants that are not listed in the appropriate section of the regulations, and GHGs are not currently included in that list. However, it should be noted that sections 52.21(m)(1)(ii) and 51.166(m)(1)(ii) of EPA's regulations apply to pollutants for which no NAAQS exists. These provisions call for collection of air quality monitoring data "as the Administrator determines is necessary to assess ambient air quality for that pollutant in any (or the) area that the emissions of that pollutant would affect." In the case of GHGs, the exemption in sections 52.21(i)(5)(iii) and 51.166(i)(5)(iii) is controlling since GHGs are not currently listed in the relevant paragraph. Nevertheless, EPA does not consider it necessary for applicants to gather monitoring data to assess ambient air quality for GHGs under section 52.21(m)(1)(ii), section 51.166(m)(1)(ii), or similar provisions that may be contained in state rules based on EPA's rules. GHGs do not affect "ambient air quality" in the sense that EPA intended when these parts of EPA's rules were initially drafted. Considering the nature of GHG emissions and their global impacts, EPA does not believe it is practical or appropriate to expect permitting authorities to collect monitoring data for purpose of assessing ambient air impacts of GHGs.

Furthermore, consistent with EPA's statement in the Tailoring Rule, EPA believes it is not necessary for applicants or permitting authorities to assess impacts from GHGs in the context of the additional impacts analysis or Class I area provisions of the PSD regulations for the following policy reasons. Although it is clear that GHG emissions contribute to global warming and other climate changes that result in impacts on the environment, including impacts on Class I areas and soils and vegetation due to the global scope of the problem, climate change modeling and evaluations of risks and impacts of GHG emissions is typically conducted for changes in emissions orders of magnitude larger than the emissions from individual projects that might be analyzed in PSD permit reviews. Quantifying the exact impacts attributable to a specific GHG source obtaining a permit in specific places and points would not be possible with current climate change modeling. Given these considerations, GHG emissions would serve as the more appropriate and credible proxy for assessing the impact of a given facility. Thus, EPA believes that the most practical way to address the considerations reflected in the Class I area and additional impacts analysis is to focus on reducing GHG emissions to the maximum extent. In light of these analytical challenges, compliance with the BACT analysis is the best technique that can be employed at present to satisfy the additional impacts analysis and Class I area requirements of the rules related to GHGs.

Applicants and permitting authorities should note that, while we are not recommending these analyses for GHG emissions, the incorporation of GHGs into the PSD program does not change the need for sources and permitting authorities to address these requirements for other regulated NSR pollutants. Accordingly, if PSD is triggered for a GHG emissions source, all regulated NSR pollutants which the source emits in significant amounts would be subject to these other PSD requirements. Therefore, if a facility triggers review for regulated NSR pollutants that are non-GHG pollutants for which there are established NAAQS or increments,

the air quality, additional impacts, and Class I requirements must be satisfied for those pollutants and the applicant and permitting authority are required to conduct the necessary analysis.

V. Title V Considerations

A. General Concepts and Title V Requirements

Under the CAA, major sources (and certain other sources) must apply for, and operate in accordance with, an operating permit that contains conditions necessary to assure compliance with all CAA requirements applicable to the source.[127] The operating permit requirements under title V are intended to improve sources' compliance with other CAA requirements. Title V generally does not add new pollution control requirements, but it does require that each permit contain all air quality control requirements or "applicable requirements" required under the CAA (*e.g.,* NSPS and SIP requirements, including PSD), and it requires that certain procedural requirements be followed, especially with respect to compliance with these requirements. "Applicable requirements" for title V purposes include stationary source requirements, but do not include mobile source requirements. Procedural requirements include providing review of permits by EPA, states, and the public, requiring permit holders to track, report, and annually certify their compliance status with respect to their permit requirements, and otherwise ensuring that permits contain conditions to assure compliance with applicable requirements.

This section discusses title V requirements as they pertain to GHGs. These include the applicability requirement for title V permitting due to GHG emissions (*e.g.*, when a source will become subject to title V for the first time due to its GHG emissions), and requirements for permit applications and permit content. Under Step 1 of the Tailoring Rule, no sources become major sources requiring a title V permit solely as a result of GHG emissions. Sources must address GHGs in a title V permit only if they must address GHGs in their PSD permit (thus, they are a PSD "anyway source" or undergo an "anyway modification"). Beginning in Step 2 of the Tailoring Rule, a stationary source may be a major source subject to title V permitting requirements solely on the basis of its GHG emissions, provided the source exceeds the thresholds established in the Tailoring Rule (discussed below).

Under both Step 1 and Step 2 of the Tailoring Rule, when a source is required to address GHGs in their title V permit, the permit needs to meet the generally applicable title V application and permitting requirements for GHGs, such as describing emissions of GHGs and including in the permit any applicable requirements for GHGs established under other CAA programs (*e.g.*, the PSD program). The source's operating permit application generally must contain emissions-related information for: (1) all pollutants for which the source is major (see the definition of "major stationary source" in 40 CFR 70.2, which incorporates the requirements that a pollutant be subject to regulation, and an emissions threshold for GHG); and (2) all emissions of "regulated air pollutants" (which, under 40 CFR 70.2, includes criteria pollutants, VOCs, and pollutants regulated under CAA Section 111 or 112 standards, but does not currently include GHGs). In addition, the permitting authority shall require sources to provide additional emissions information sufficient to verify which requirements are applicable to the source and

[127] Details of the title V program are addressed in rules promulgated by EPA – 40 CFR 70 addresses programs implemented by state and local agencies and tribes, and 40 CFR 71 addresses programs generally implemented by EPA.

other specific information that may be necessary to implement and enforce other applicable requirements of the CAA or to determine the applicability of such requirements.[128]

Since the Tailoring Rule establishes a phased applicability approach under title V, the pertinent requirements vary somewhat between the first two steps of the Tailoring Rule. The following is a summary of the key requirements and some general examples with respect to title V applicability and title V permitting requirements (including permit application and permit content) with respect to GHGs under Steps 1 and 2 of the Tailoring Rule.

B. Title V Applicability Requirements and GHGs

Applicability requirements for title V permitting as they apply to GHG emissions are summarized in the following table and explained in more detail in subsections V.B.1 and V.B.2 following the table:

Table V-A. Summary of Title V Applicability Criteria for Sources of GHGs

January 2, 2011, to June 30, 2011 (Step 1 of the Tailoring Rule)	**On or after July 1, 2011 (Step 2 of the Tailoring Rule)**
No sources are subject to title V permitting solely as a result of their emissions of GHGs. (Thus, no new title V sources come into the title V program as a result of GHG emissions.) [However, for sources subject to, or that become newly subject to, title V for non-GHG pollutants (*i.e.,* PSD "anyway sources"), sources and permitting authorities need to meet the generally applicable title V application and permitting requirements as necessary to address GHGs, such as including in the permit any applicable requirements for GHGs established under other CAA programs.]*	The following sources are subject to title V permitting requirements as a result of their GHG emissions: • Existing or newly constructed GHG emission sources (not already subject to title V) that emit or have a PTE equal to or greater than: o 100,000 TPY CO_2e, **and** o 100 TPY GHGs mass basis [As with Step 1, for all PSD "anyway sources" subject to title V in Step 2, sources and permitting authorities need to meet the generally applicable title V application and permitting requirements as necessary to address GHGs, such as including in the permit any applicable requirements for GHGs established under other CAA programs]*

* It is expected, at least at the outset, that this will consist primarily of meeting application and permitting requirements necessary to assure compliance with PSD permitting requirements for GHGs. See accompanying text in Section V.C of this guidance for further discussion and examples.

1. *Applicability under Tailoring Rule Step* 1

Under Step 1, no sources are subject to title V permitting solely as a result of their emissions of GHGs. Thus no new title V sources come into the title V program solely as a result of GHG emissions. However, sources required to have title V permits because they are PSD "anyway sources" or undergo PSD "anyway modifications" will be required to address GHGs as

[128] 40 CFR 70.5.

part of their title V permitting to the extent necessary to assure compliance with GHG applicable requirements established under other CAA programs. Section C below describes how sources and permitting authorities should consider addressing GHG requirements in permitting actions.

2. *Applicability under Tailoring Rule Step 2*

Beginning in Step 2 of the Tailoring Rule, a stationary source may be a major source subject to title V permitting requirements solely on the basis of its GHG emissions, provided the source exceeds the thresholds established in the Tailoring Rule. GHG emission sources that emit or have the PTE at least 100,000 TPY CO_2e, and also emit or have the PTE 100 TPY of GHGs on a mass basis will be required to obtain a title V permit if they do not already have one. It is important to note that the requirement to obtain a title V permit will not, by itself, result in the triggering of additional substantive requirements for control of GHG. Rather, these new title V permits will simply incorporate whatever applicable CAA requirements, if any, apply to the source being permitted.

Both of the following conditions need to be met in order for title V to apply under Step 2 of the Tailoring Rule to a GHG emission source:

(1) An existing or newly constructed source emits or has the PTE GHGs in amounts that equal or exceed 100 TPY calculated as the sum of the six well-mixed GHGs on a mass basis (no GWPs applied).

(2) An existing or newly constructed source emits or has the PTE GHGs in amounts that equal or exceed 100,000 TPY calculated as the sum of the six well-mixed GHGs on a CO_2e basis (GWPs applied).

In Step 2, as under Step 1, for all sources otherwise subject to title V for non-GHG pollutants (*i.e.,* anyway sources), sources and permitting authorities will need to meet the generally applicable title V application and permitting requirements as they pertain to GHG applicable requirements established under other CAA programs (*e.g.,* the PSD program). See Section C below for further discussion of permitting requirements.

C. Permitting Requirements

Under both Steps 1 and 2 of the Tailoring Rule, as with other applicable requirements related to non-GHG pollutants, any applicable requirement for GHGs must be addressed in the title V permit (*i.e.,* the permit must contain conditions necessary to assure compliance with applicable requirements for GHGs). EPA anticipates that the initial applicable requirements for GHGs will be in the form of GHG control requirements resulting from PSD permitting actions. It is important to note that GHG reporting requirements for sources established under EPA's final rule for the mandatory reporting of GHGs (40 CFR Part 98: Mandatory Greenhouse Gas Reporting, hereafter referred to as the "GHG reporting rule") are currently not included in the definition of applicable requirement in 40 CFR 70.2 and 71.2. Although the requirements contained in the GHG reporting rule currently are not considered applicable requirements under

the title V regulations, the source is not relieved from the requirement to comply with the GHG reporting rule separately from compliance with their title V operating permit. It is the responsibility of each source to determine the applicability of the GHG reporting rule and to comply with it, as necessary. However, since the requirements of the GHG reporting rule are not considered applicable requirements under title V, they do not need to be included in the title V permit.

Under both Steps 1 and 2 of the Tailoring Rule, sources will need to include in their title V permit applications, among other things: citation and descriptions of any applicable requirements for GHGs (*e.g.,* GHG BACT requirements resulting from a PSD review process), information pertaining to any associated monitoring and other compliance activities, and any other information considered necessary to determine the applicability of, and impose, any applicable requirements for GHGs. This is the same application information required under title V for applicable requirements pertaining to conventional pollutants.

As a general matter, all title V permits issued by permitting authorities must contain, among other things, emissions limitations and standards necessary to assure compliance with all applicable requirements for GHGs, all monitoring and testing required by applicable requirements for GHGs, and additional compliance certification, testing, monitoring, reporting, and recordkeeping requirements sufficient to assure compliance with GHG-related terms and conditions of the permit. Permitting authorities will also need to request from sources any information deemed necessary to determine or impose GHG applicable requirements.

It is possible that some sources will need to address GHG-related information in their applications even if they will ultimately not have any GHG-specific applicable requirements (such as a PSD-related BACT requirement for GHGs) included in their permit. This is because, as noted above, permitting authorities would need to request information related to identifying GHG emission sources and other information if they determine such information is necessary to determine applicable requirements. Following is an explanation of the basis for requesting this information and some examples of these types of scenarios under Steps 1 and 2 of the Tailoring Rule.

Under Step 1 of the Tailoring Rule, no source can be major for purposes of title V solely on the basis of its GHG emissions, so the requirement set forth in 40 CFR 70.5 for the source to provide emissions-related information for pollutants for which the source is major does not apply. In addition, as GHGs are not currently considered regulated air pollutants under the title V regulations, the requirement to provide emissions-related information for regulated air pollutants does not apply. However, consistent with the requirements set forth in 40 CFR 70.5, permitting authorities will need to ask for any emissions or other information they deem necessary to determine applicability of, or impose, a CAA requirement.[129] Therefore, during Step 1 of the Tailoring Rule, any source going through a title V permitting action (*i.e.,* applying for a title V operating permit or undergoing a permit revision, reopening or renewal) would need

[129] Note that the phrase "subject to regulation" in the definition of major source in the title V regulations affects when a source may be a major source subject to title V as a result of emissions of a pollutant. If a source is already subject to title V, its application must include any information considered necessary to determine or impose a GHG applicable requirement – this is true even before GHGs become "subject to regulation" for major sources purposes.

to provide GHG emissions or other information if a permitting authority needs the information to determine applicability of a CAA requirement (*e.g.*, PSD).[130] The following is an example of where this request for information might occur:

> *An existing title V source is making a physical change that triggers PSD for NO_X. This change will result in additional applicable requirements for NO_X emissions controls but, according to the applicant, does not trigger BACT review for GHGs. In this case, as part of its analysis of the application for permit revision under its title V program, the permitting authority may determine it necessary to verify that the project did not trigger BACT requirements for GHG emissions, and therefore may need to request the applicant to submit GHG emissions information related to the project sufficient for the permitting authority to determine that PSD did not apply for GHG emissions from the project. This information could include such items as identification and descriptions of any GHG emission units and estimates of GHG emissions associated with the modification project.*

Under Step 2 of the Tailoring Rule, beginning July 1, 2011, a stationary source may be subject to title V permitting requirements solely on the basis of its GHG emissions, provided the source is equal to or greater than the 100,000 TPY CO_2e subject to regulation threshold (as well as the 100 TPY major source mass-based threshold) on a PTE basis. As noted above, sources generally must provide information regarding all emissions of pollutants for which they are major. In many cases, particularly where the source has no applicable requirements for GHGs, emissions descriptions (instead of estimates) may be sufficient. For sources subject to the GHG reporting rule, the emissions description requirements in the title V rules will generally be satisfied by information provided under the reporting rule. Further elaboration on the requirement for emissions data is provided in the White Paper 1 guidance on title V.[131] The following is an example of a permitting scenario under title V during Step 2 of the Tailoring Rule:

> *As of July 1, 2011, an existing facility not previously subject to title V has a GHG PTE over 100,000 TPY CO_2e and over 100 TPY on a mass basis. Therefore, according to the Tailoring Rule applicability criteria for GHG sources, this source becomes subject to title V solely based on its GHG emissions as of July 1, 2011. First, it will need to apply for a title V permit within 12 months of July 1, 2011 (unless an earlier date has been established by the permitting authority). Second, assuming that the facility does not have any applicable requirements for GHG emissions (such as a GHG BACT requirement resulting from a PSD review), the permitting authority may deem it sufficient that the facility simply provide a description of the GHG emission sources at the facility that cause the facility to exceed the applicability criteria threshold for GHGs under title V, rather than a detailed quantification of its GHG emission sources. Lastly, the source would also need to provide other emissions information as necessary for non-GHG emission sources (e.g., information on emissions of regulated air pollutants, information for fee calculation, etc.)*

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[130] 40 CFR 70.5(c)(5).

[131] Office of Air Quality Planning and Standards, *White Paper for Streamlined Development of Part 70 Permit Applications* (July 10, 1995).

It is also important to note that sources that are newly subject to title V solely as a result of their GHG emissions will also need to provide in their title V permit applications required information regarding all other applicable requirements that apply to it under the Act (*e.g.,* SIP regulations). The following is an example of this permitting scenario under Step 2 of the Tailoring Rule:

> *A facility becomes subject to title V permitting requirements solely on the basis of its GHG emissions on July 2, 2011, and, therefore, must apply for a title V permit. The facility has an applicable requirement, such as a SIP requirement imposing an opacity limit on fuel-burning equipment that lacks periodic monitoring and monitoring sufficient to assure compliance. Even if the newly subject title V source did not have any specific GHG-related requirements to include in the title V permit, under this scenario, the facility must propose appropriate monitoring, recordkeeping and reporting (MRR) to assure compliance with the opacity standard in its permit application and the permitting authority must add appropriate MRR to the operating permit for that opacity standard (which may be the MRR proposed by the facility or other requirements) under the authority of the Act.*

D. Title V Fees

EPA rules currently do not require sources to pay any title V fees based on GHG emissions or to otherwise quantify GHG emissions strictly for title V fee purposes. However, throughout Steps 1 and 2 of the Tailoring Rule, the statutory and regulatory requirement to collect fees sufficient to cover all reasonable (direct and indirect) costs required to develop and administer title V programs still applies.[132] Permitting authorities need to review resource needs for GHG-emitting sources and determine if their existing fee structure is adequate. If not, permitting authorities would need to raise fees to cover the direct and indirect costs of the program or develop alternative approaches. EPA will work with permitting authorities that request assistance concerning establishing title V fees related to GHG emissions.

E. Flexible Permits

The final Flexible Air Permitting Rule (74 FR 51418), promulgated on October 6, 2009, reflects EPA's policy and rules governing the use of flexible air permits. A flexible air permit (FAP) is a title V operating permit that by its design authorizes the source owner to make certain types or categories of physical and/or operational changes without further review or approval of the individual changes by the permitting authority. Flexible air permits cannot circumvent, modify, or contravene any applicable requirement and, instead, by their design must assure compliance with each one. Based on our evaluation of State FAP pilots in addition to providing greater operational flexibility, FAPs can result in greater environmental protection, lower administrative costs, pollution prevention and increased energy efficiency.

[132] 42 USC 7661a(b)(3)(B); 40 CFR 70.9.

FAP approaches can significantly reduce the administrative resources associated with CAA permitting requirements and provide a streamlined path for installing new energy-efficient equipment at industrial facilities. While many energy-efficient equipment upgrades may not trigger air permitting requirements, some changes have the potential to trigger permitting actions or applicability determination activities. The combination of plantwide emissions limits, alternative operating scenarios, and/or advance approvals of categories of operational changes can eliminate the need for case-by-case evaluation (under title V and PSD/NSR) for future energy-efficient equipment upgrades, thereby reducing time delays, uncertainty, and transaction costs in making these changes. In the absence of FAP approaches, air permitting considerations may cause a facility to forego or delay energy-efficient equipment upgrades that have potential to trigger air permitting requirements. FAP approaches can be used to accommodate these types of changes in a streamlined manner that addresses all applicable regulatory requirements up-front.

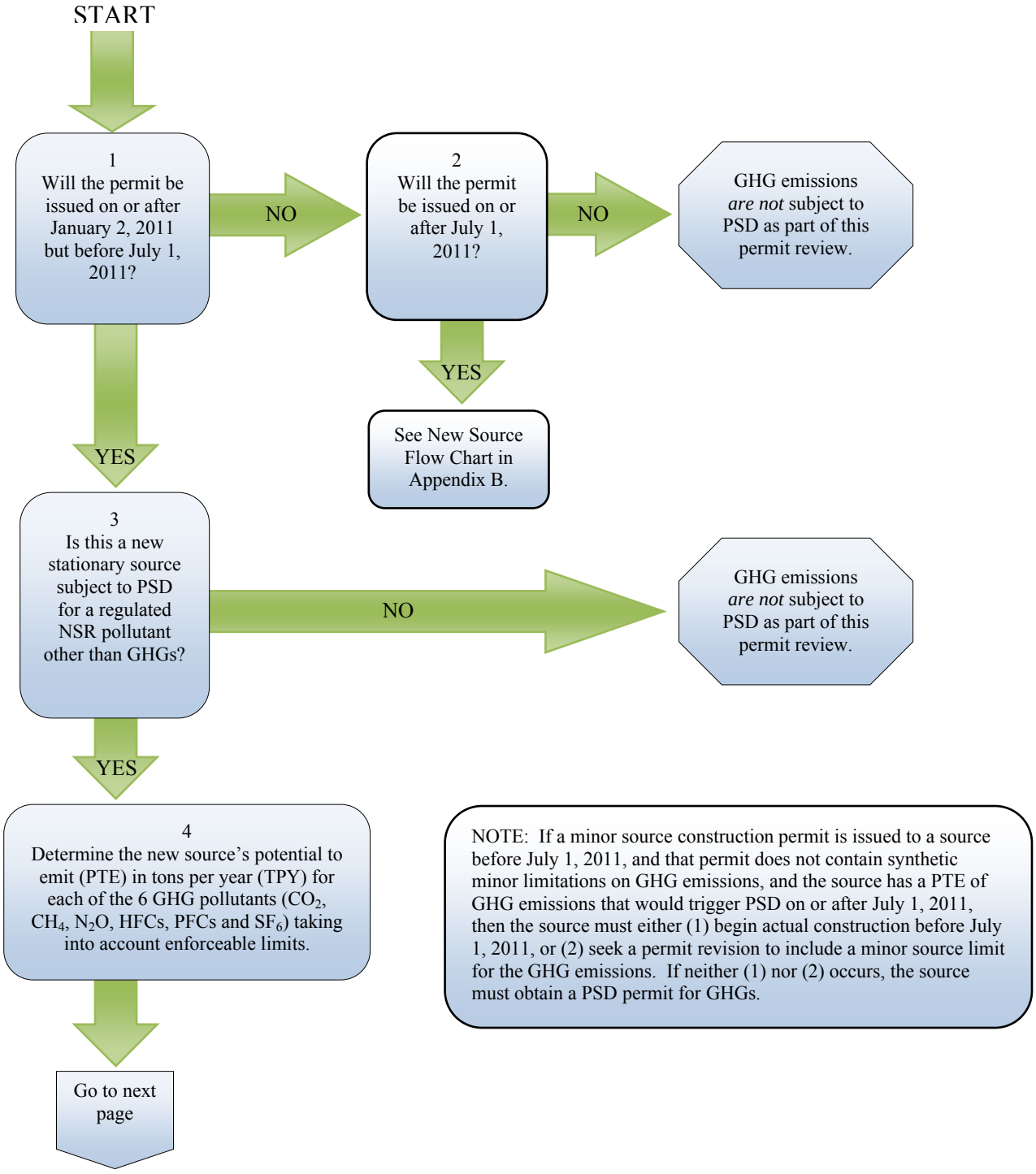
EPA encourages permitting authorities and sources to consider FAPs, particularly in situations where a source is planning to implement an ongoing program designed to improve energy efficiency and reduce GHG over time.

VI. Appendices

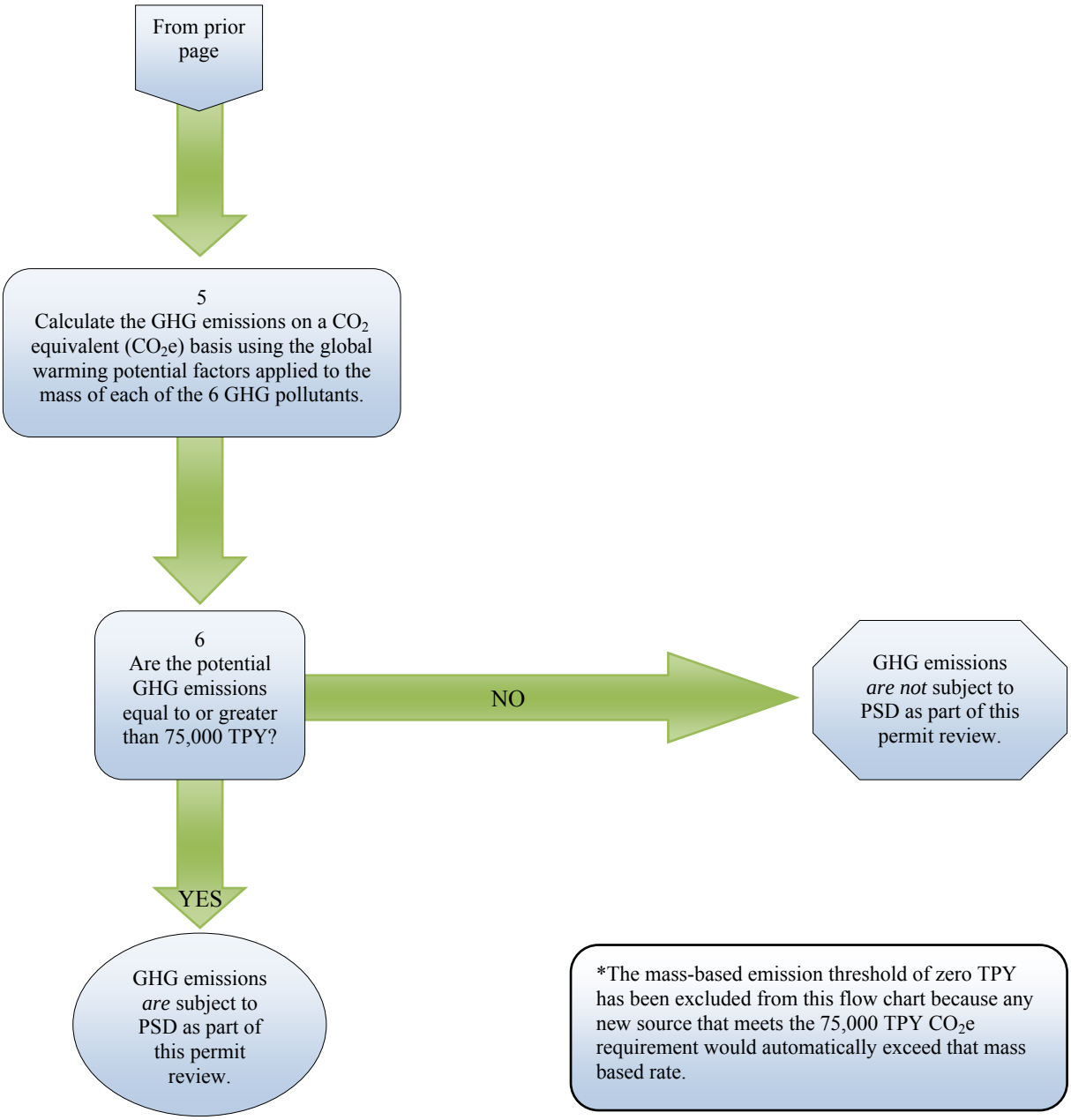
Note: The regulatory changes implemented in the Tailoring Rule set forth a two-part applicability process determining the applicability of PSD to GHGs, which first evaluates the sum of the GHG emissions on a CO_2e basis in order to determine whether the source's emissions are a regulated NSR pollutant, and, if so, then evaluates the sum of the GHG emissions on a mass basis in order to determine if there is a major source or major modification of such emissions. However, we noted in the Tailoring Rule preamble that most sources are likely to treat the mass-based analysis as an initial screen from a practical standpoint, since they would not proceed to calculate emissions on a CO_2e basis if they would not trigger PSD or title V on a mass basis.[133] Accordingly, the examples provided in the attached appendices take a variety of approaches for undertaking the required CO_2e and mass-based calculations, and permit applicants and permitting authorities may use the processes identified in this guidance or another process for determining applicability of PSD to GHGs in permits they issue, so long as their process complies with the relevant statutory and regulatory requirements.

[133] 75 FR 31514, 31522 (June 3, 2010).

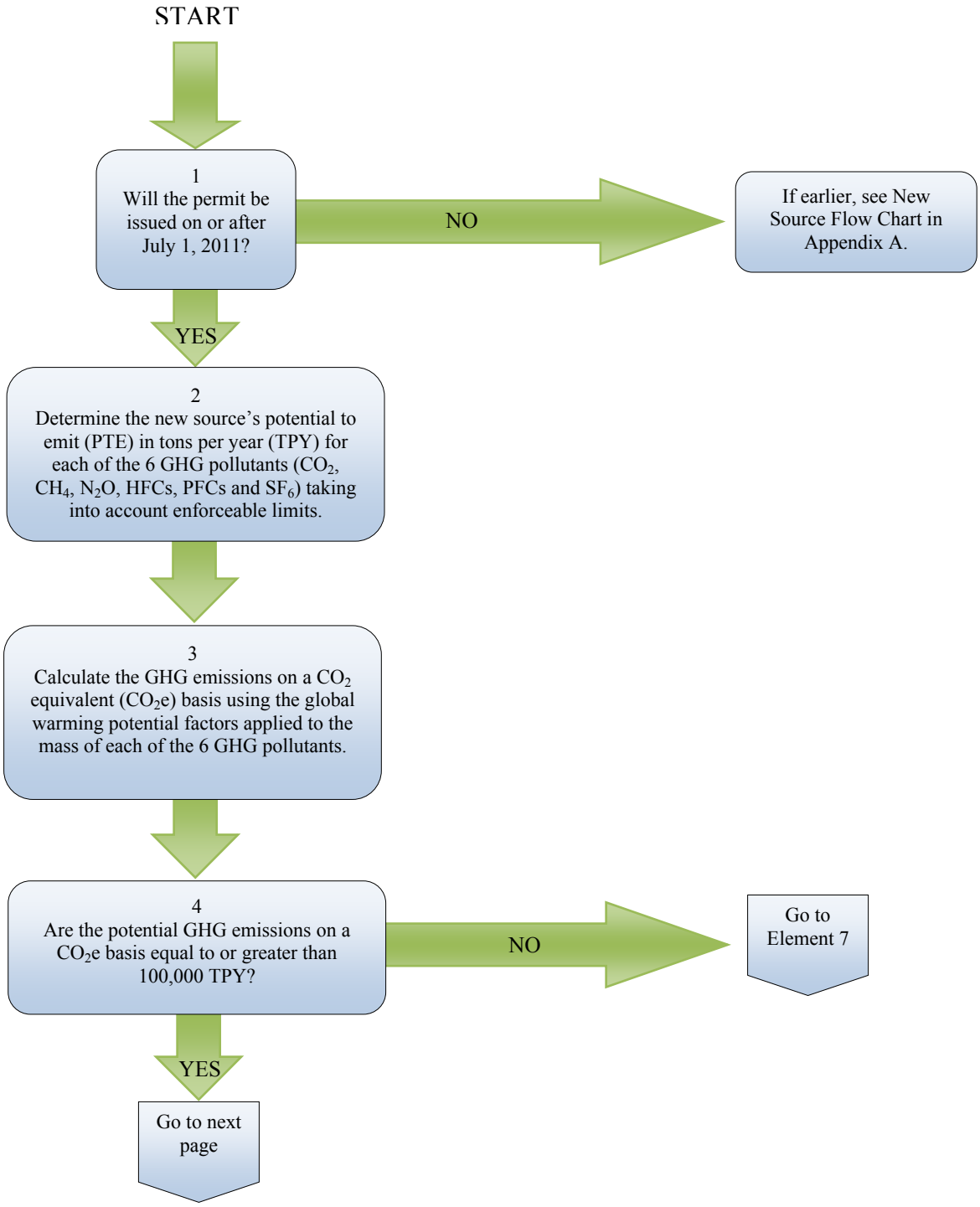
Appendix A. GHG Applicability Flow Chart – New Sources (January 2, 2011, through June 30, 2011)

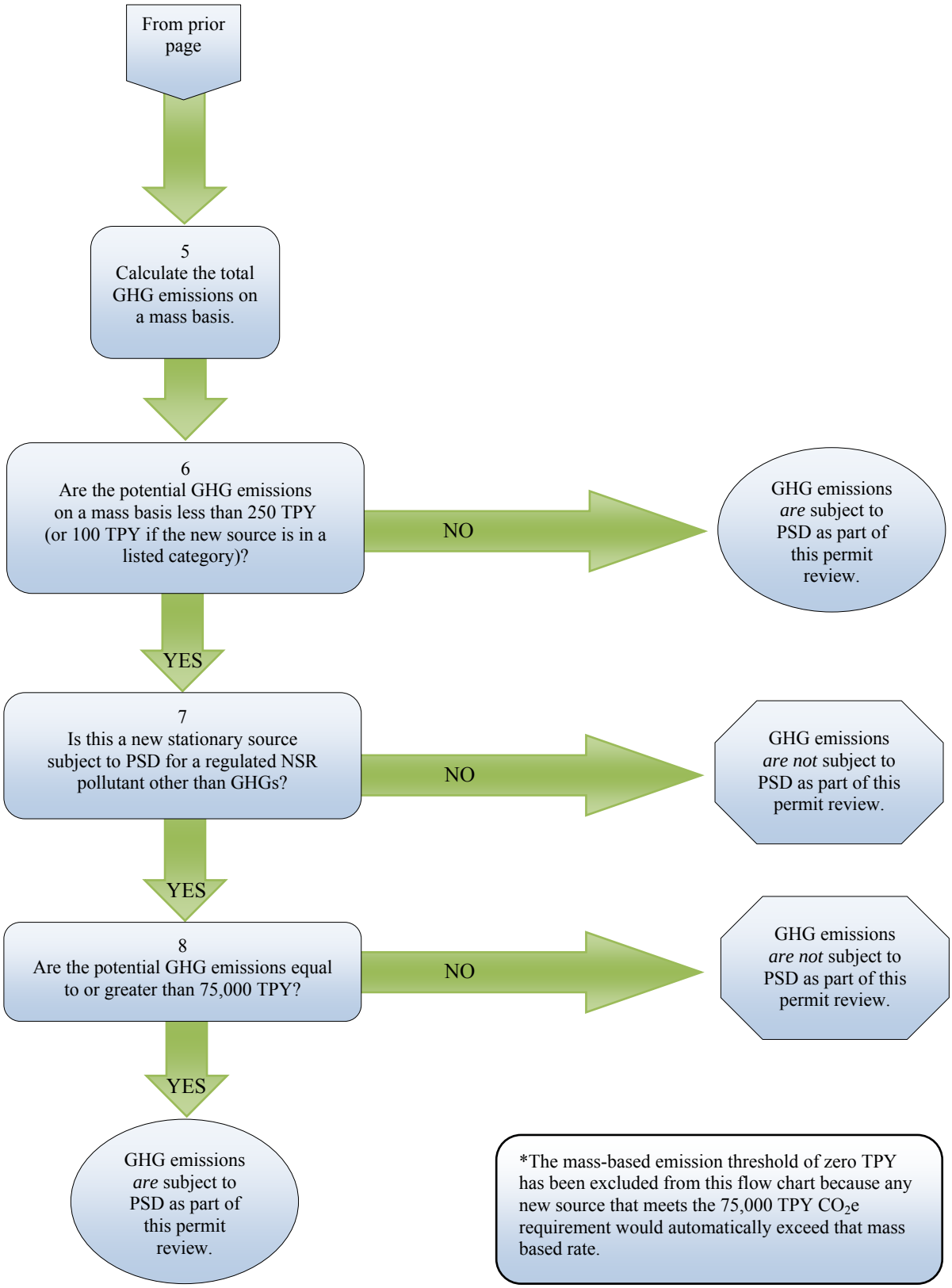


NOTE: If a minor source construction permit is issued to a source before July 1, 2011, and that permit does not contain synthetic minor limitations on GHG emissions, and the source has a PTE of GHG emissions that would trigger PSD on or after July 1, 2011, then the source must either (1) begin actual construction before July 1, 2011, or (2) seek a permit revision to include a minor source limit for the GHG emissions. If neither (1) nor (2) occurs, the source must obtain a PSD permit for GHGs.

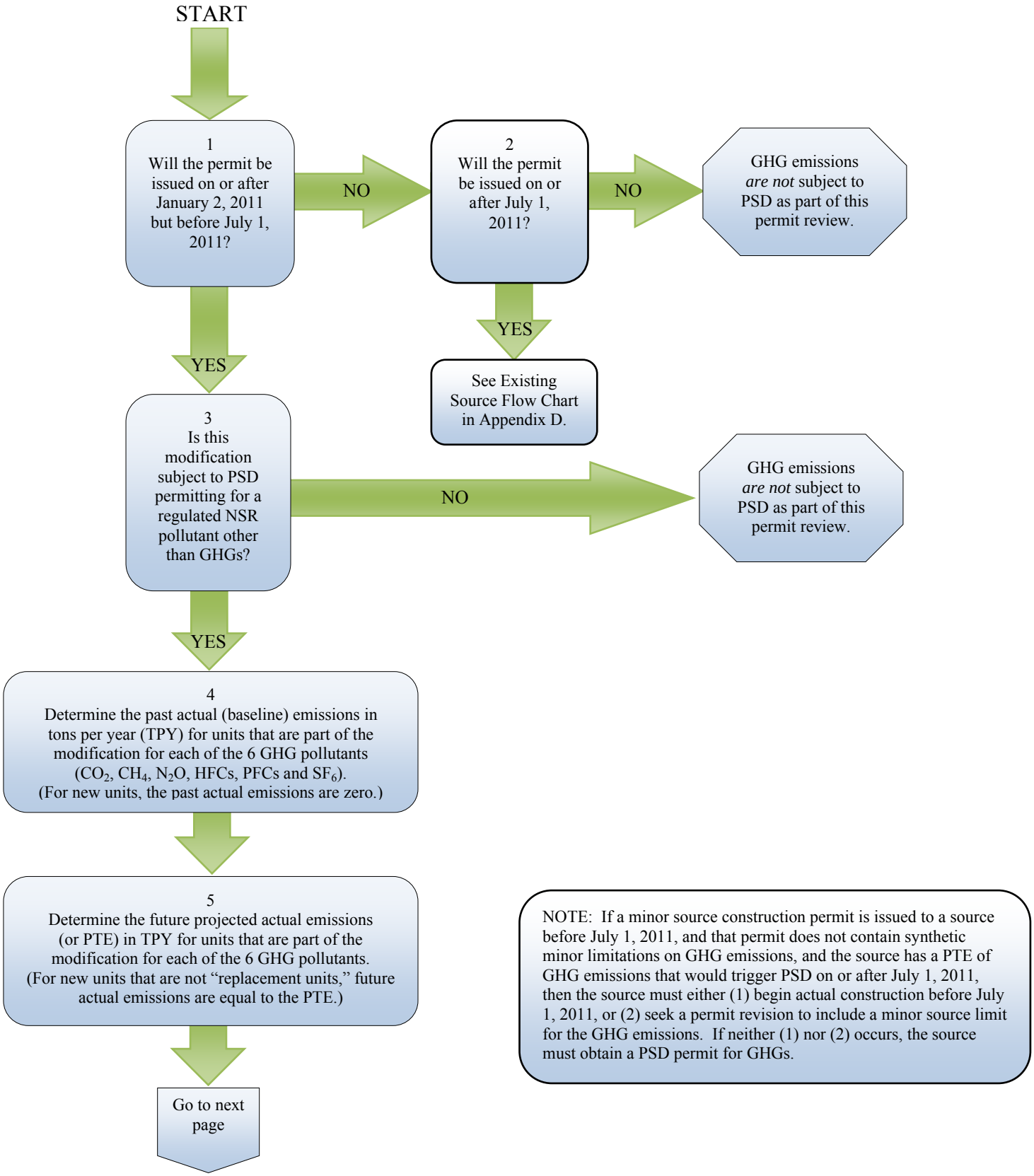

From prior page
5
Calculate the GHG emissions on a CO_2 equivalent (CO_2e) basis using the global warming potential factors applied to the mass of each of the 6 GHG pollutants.
6
Are the potential GHG emissions equal to or greater than 75,000 TPY?
NO
GHG emissions *are not* subject to PSD as part of this permit review.
YES
GHG emissions *are* subject to PSD as part of this permit review.
*The mass-based emission threshold of zero TPY has been excluded from this flow chart because any new source that meets the 75,000 TPY CO_2e requirement would automatically exceed that mass based rate.

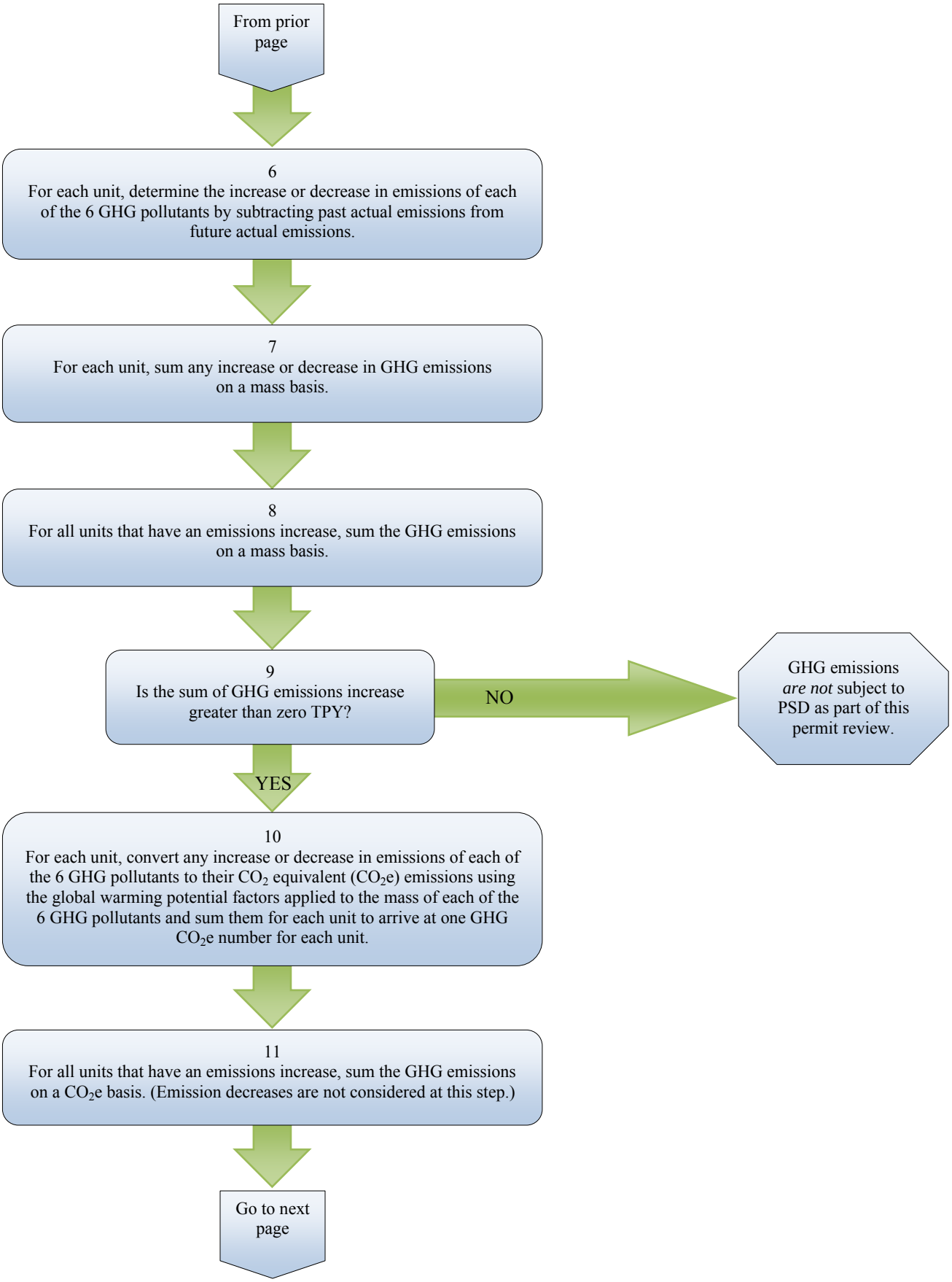
Appendix B. GHG Applicability Flow Chart – New Sources (On or after July 1, 2011)

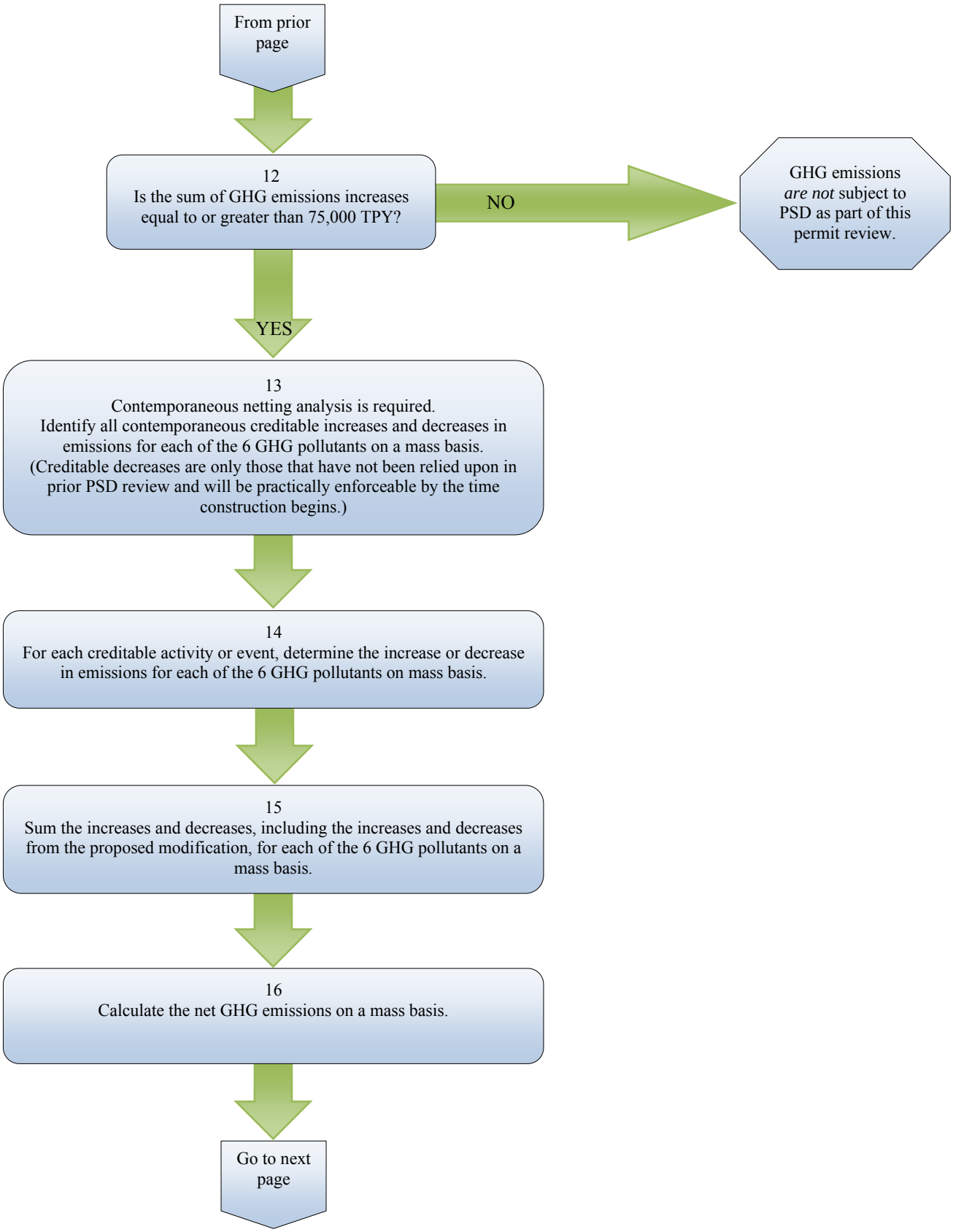


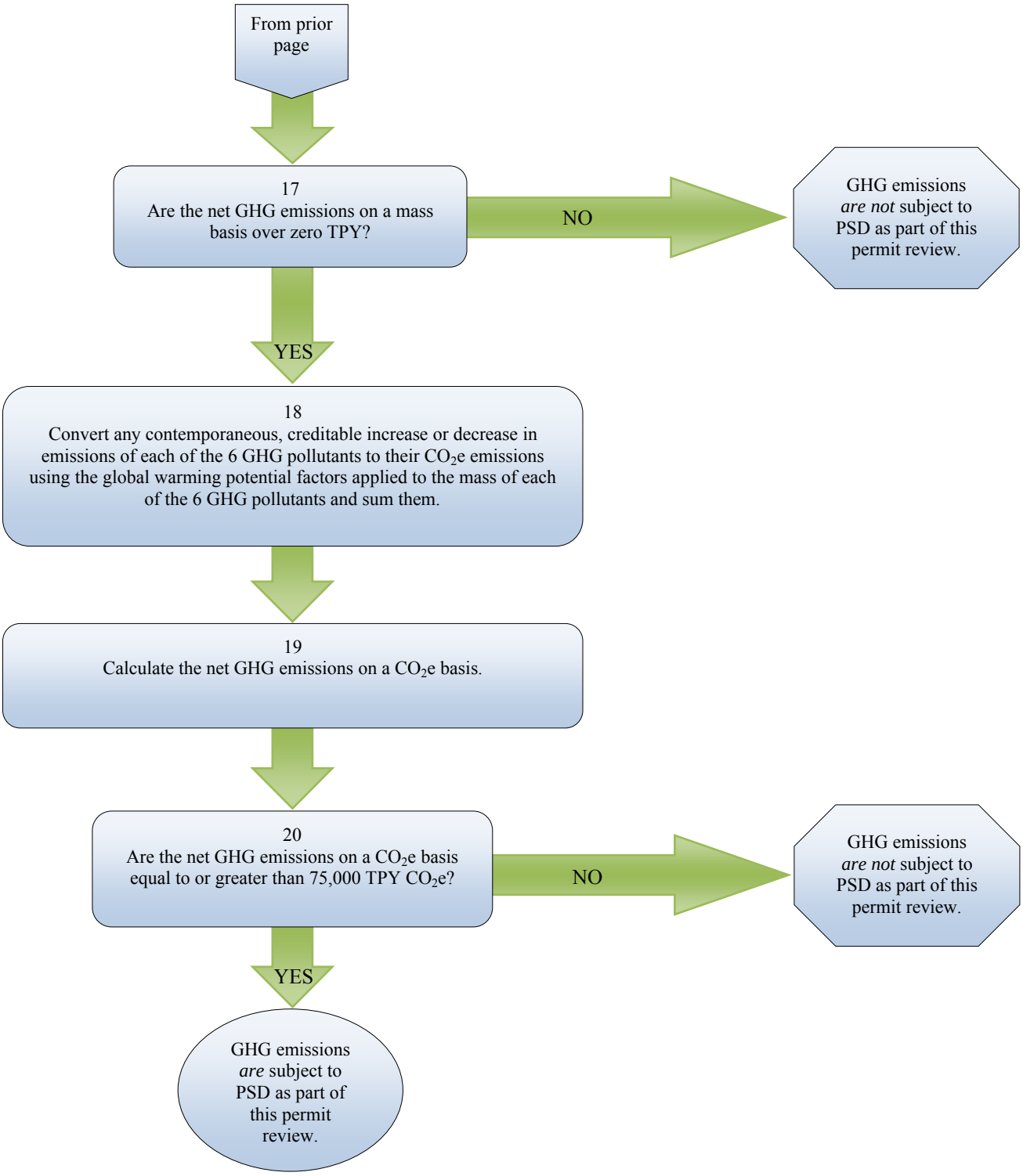

From prior page
5
Calculate the total GHG emissions on a mass basis.
6
Are the potential GHG emissions on a mass basis less than 250 TPY (or 100 TPY if the new source is in a listed category)?
NO
GHG emissions *are* subject to PSD as part of this permit review.
YES
7
Is this a new stationary source subject to PSD for a regulated NSR pollutant other than GHGs?
NO
GHG emissions *are not* subject to PSD as part of this permit review.
YES
8
Are the potential GHG emissions equal to or greater than 75,000 TPY?
NO
GHG emissions *are not* subject to PSD as part of this permit review.
YES
GHG emissions *are* subject to PSD as part of this permit review.
*The mass-based emission threshold of zero TPY has been excluded from this flow chart because any new source that meets the 75,000 TPY CO_2e requirement would automatically exceed that mass based rate.

Appendix C. GHG Applicability Flow Chart – Modified Sources (January 2, 2011, through June 30, 2011)

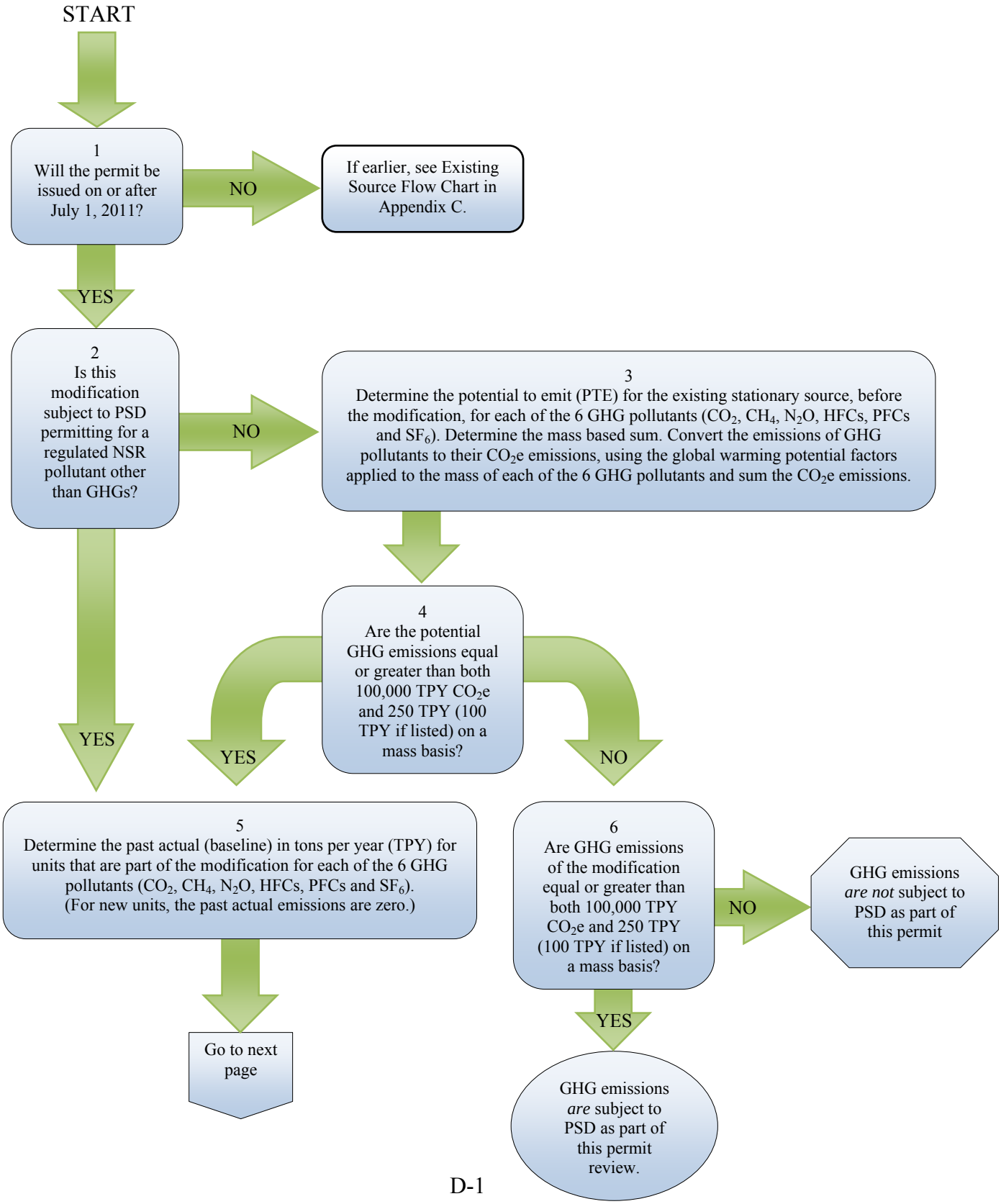


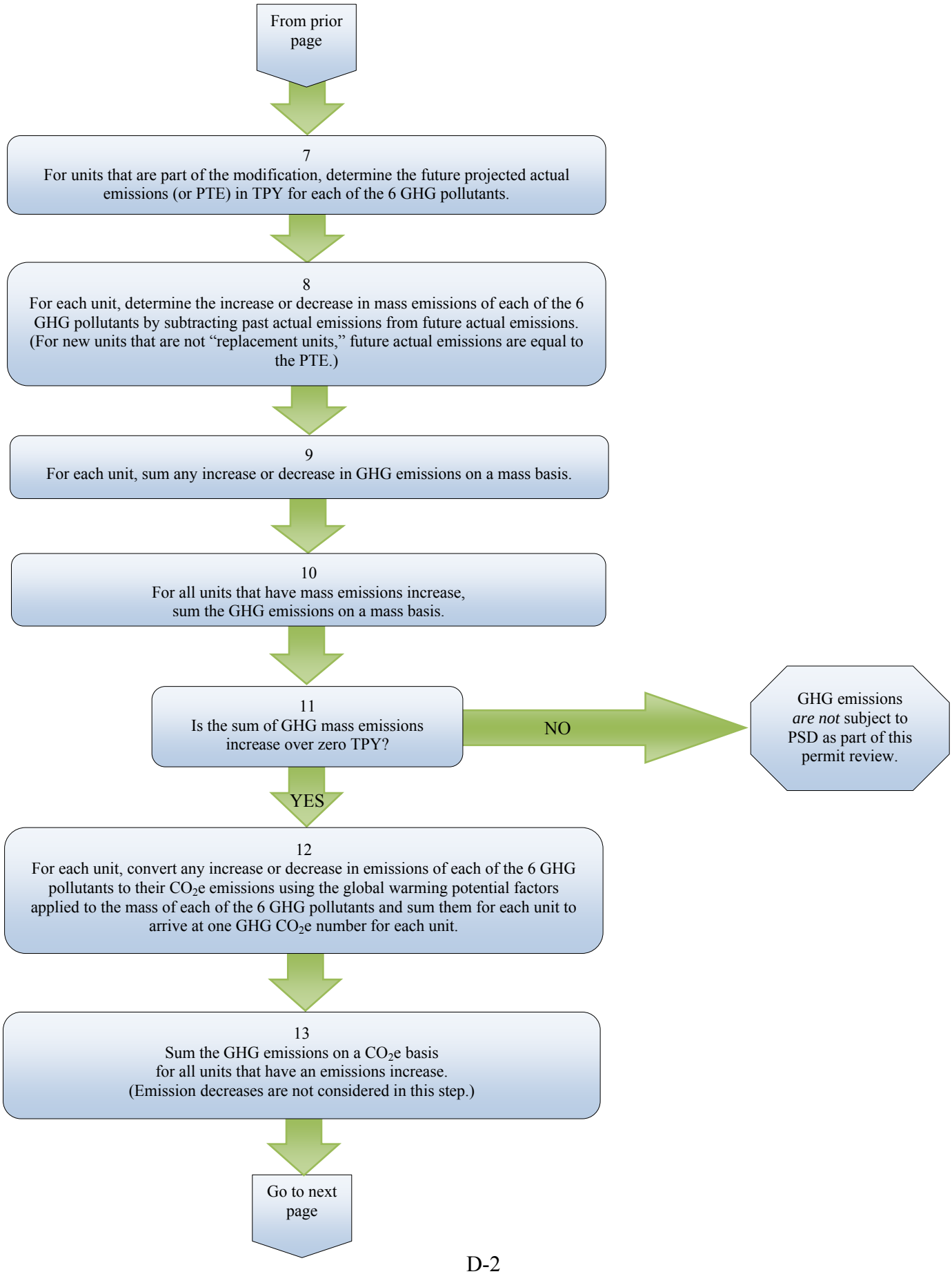

From prior page
6
For each unit, determine the increase or decrease in emissions of each of the 6 GHG pollutants by subtracting past actual emissions from future actual emissions.
7
For each unit, sum any increase or decrease in GHG emissions on a mass basis.
8
For all units that have an emissions increase, sum the GHG emissions on a mass basis.
9
Is the sum of GHG emissions increase greater than zero TPY?
NO
GHG emissions *are not* subject to PSD as part of this permit review.
YES
10
For each unit, convert any increase or decrease in emissions of each of the 6 GHG pollutants to their CO_2 equivalent (CO_2e) emissions using the global warming potential factors applied to the mass of each of the 6 GHG pollutants and sum them for each unit to arrive at one GHG CO_2e number for each unit.
11
For all units that have an emissions increase, sum the GHG emissions on a CO_2e basis. (Emission decreases are not considered at this step.)
Go to next page

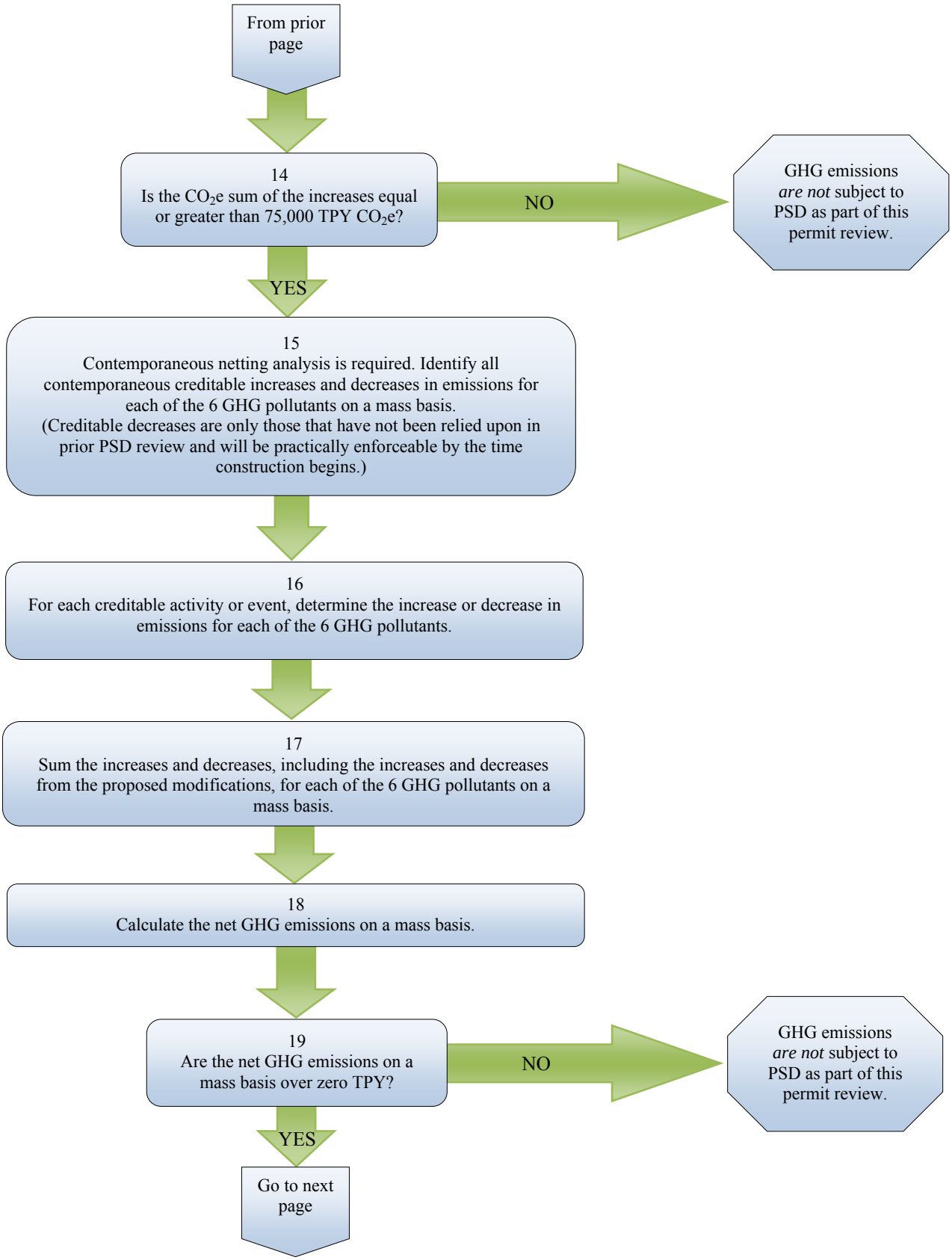

From prior page
12
Is the sum of GHG emissions increases equal to or greater than 75,000 TPY?
NO
GHG emissions *are not* subject to PSD as part of this permit review.
YES
13
Contemporaneous netting analysis is required.
Identify all contemporaneous creditable increases and decreases in emissions for each of the 6 GHG pollutants on a mass basis.
(Creditable decreases are only those that have not been relied upon in prior PSD review and will be practically enforceable by the time construction begins.)
14
For each creditable activity or event, determine the increase or decrease in emissions for each of the 6 GHG pollutants on mass basis.
15
Sum the increases and decreases, including the increases and decreases from the proposed modification, for each of the 6 GHG pollutants on a mass basis.
16
Calculate the net GHG emissions on a mass basis.
Go to next page

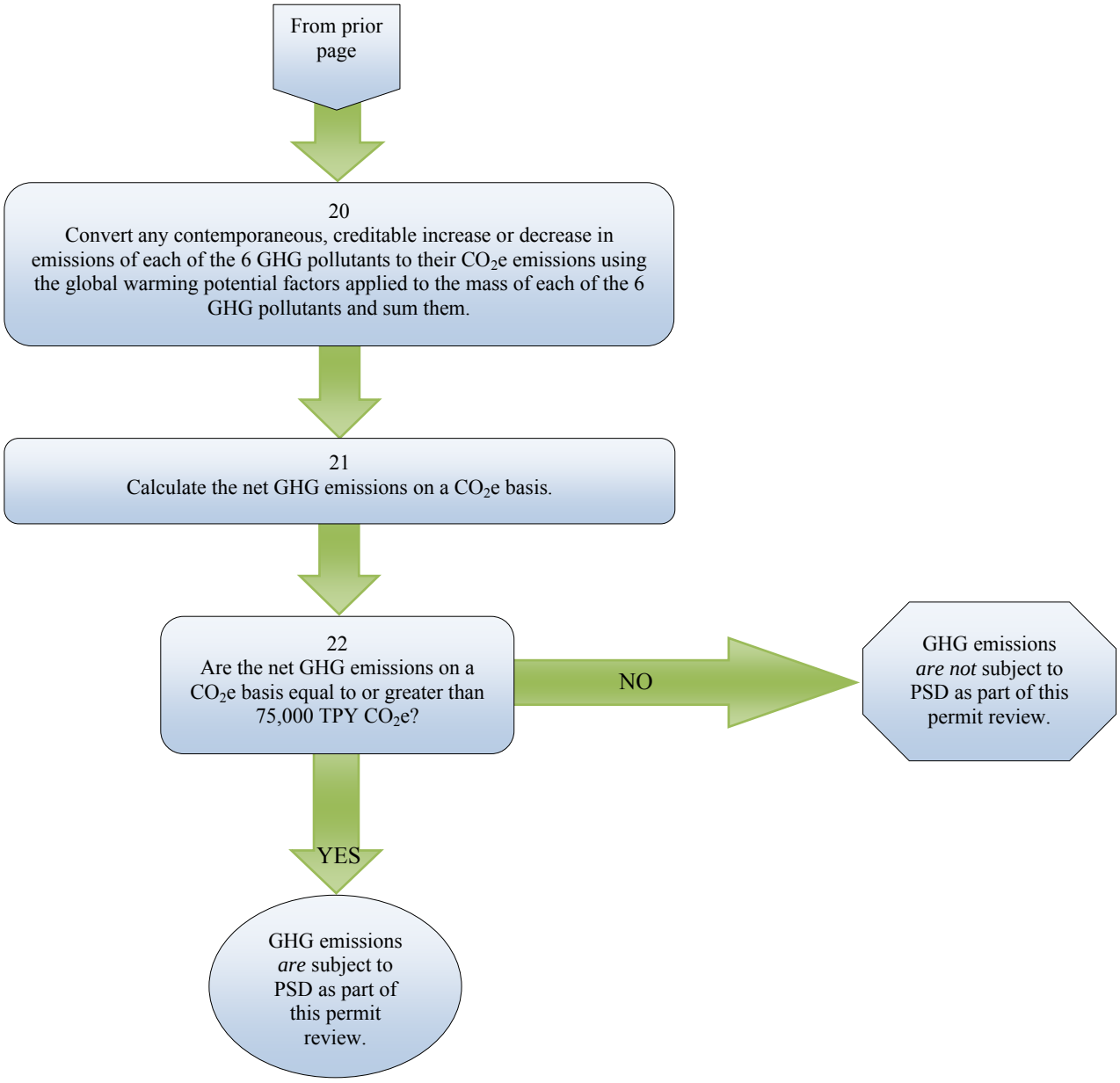

From prior page
17
Are the net GHG emissions on a mass basis over zero TPY?
NO
GHG emissions *are not* subject to PSD as part of this permit review.
YES
18
Convert any contemporaneous, creditable increase or decrease in emissions of each of the 6 GHG pollutants to their CO_2e emissions using the global warming potential factors applied to the mass of each of the 6 GHG pollutants and sum them.
19
Calculate the net GHG emissions on a CO_2e basis.
20
Are the net GHG emissions on a CO_2e basis equal to or greater than 75,000 TPY CO_2e?
NO
GHG emissions *are not* subject to PSD as part of this permit review.
YES
GHG emissions *are* subject to PSD as part of this permit review.

Appendix D. GHG Applicability Flowchart – Modified Sources (On or after July 1, 2011)




From prior page
7
For units that are part of the modification, determine the future projected actual emissions (or PTE) in TPY for each of the 6 GHG pollutants.
8
For each unit, determine the increase or decrease in mass emissions of each of the 6 GHG pollutants by subtracting past actual emissions from future actual emissions. (For new units that are not "replacement units," future actual emissions are equal to the PTE.)
9
For each unit, sum any increase or decrease in GHG emissions on a mass basis.
10
For all units that have mass emissions increase, sum the GHG emissions on a mass basis.
11
Is the sum of GHG mass emissions increase over zero TPY?
NO
GHG emissions *are not* subject to PSD as part of this permit review.
YES
12
For each unit, convert any increase or decrease in emissions of each of the 6 GHG pollutants to their CO_2e emissions using the global warming potential factors applied to the mass of each of the 6 GHG pollutants and sum them for each unit to arrive at one GHG CO_2e number for each unit.
13
Sum the GHG emissions on a CO_2e basis for all units that have an emissions increase. (Emission decreases are not considered in this step.)
Go to next page


From prior page
14
Is the CO_2e sum of the increases equal or greater than 75,000 TPY CO_2e?
NO
GHG emissions *are not* subject to PSD as part of this permit review.
YES
15
Contemporaneous netting analysis is required. Identify all contemporaneous creditable increases and decreases in emissions for each of the 6 GHG pollutants on a mass basis.
(Creditable decreases are only those that have not been relied upon in prior PSD review and will be practically enforceable by the time construction begins.)
16
For each creditable activity or event, determine the increase or decrease in emissions for each of the 6 GHG pollutants.
17
Sum the increases and decreases, including the increases and decreases from the proposed modifications, for each of the 6 GHG pollutants on a mass basis.
18
Calculate the net GHG emissions on a mass basis.
19
Are the net GHG emissions on a mass basis over zero TPY?
NO
GHG emissions *are not* subject to PSD as part of this permit review.
YES
Go to next page


From prior page
20
Convert any contemporaneous, creditable increase or decrease in emissions of each of the 6 GHG pollutants to their CO_2e emissions using the global warming potential factors applied to the mass of each of the 6 GHG pollutants and sum them.
21
Calculate the net GHG emissions on a CO_2e basis.
22
Are the net GHG emissions on a CO_2e basis equal to or greater than 75,000 TPY CO_2e?
NO
GHG emissions *are not* subject to PSD as part of this permit review.
YES
GHG emissions *are* subject to PSD as part of this permit review.

Appendix E. Example of PSD Applicability for a Modified Source

Example Scenario:

- An existing stationary source is major for PSD and modifications involving GHGs may be major and possibly subject to PSD.
- The proposed modification consists of the addition of a new emissions unit (Unit #2) and a modification to existing emissions unit (Unit #1). Both units emit one or more compounds identified as a GHG.
- Emissions Unit A was added at the source 3 years ago.
- The GHG emissions used in PSD applicability analyses is a sum of the compounds emitted at the emission unit.

Unit #2 A new emissions unit with a proposed emissions **increase** of 77,000 TPY of CO_2 (1 x 77,000 TPY CO_2 = 77,000 TPY CO_2e).[134]

Unit #1 The modified existing Unit #1 will result in a CO_2 emissions **increase** of 50 TPY (1 x 50 TPY = 50 TPY CO_2e) and a CH_4 emissions **decrease** of 90 TPY (21 x 90 TPY CH_4 = 1890 TPY CO_2e). The pre- and post-change emissions are:

- Baseline actual GHG mass emissions are 400 TPY of CO_2 and 100 TPY of CH_4, which is a total of 500 TPY of GHGs on a mass basis.
- Proposed GHG emissions after the change are 460 TPY (450 TPY from CO_2, 10 TPY from CH_4), which is a 40 TPY decrease from baseline actual emissions on a mass basis.
- Baseline actual CO_2e emissions are 400 TPY CO_2e (1 x 400 TPY of CO_2) plus 2,100 TPY of CO_2e (21 x 100 TPY of CH_4) = 2500 TPY of CO_2e.
- Proposed CO_2e emissions after the change are 450 TPY of CO_2e (1 x 450 TPY of CO_2) plus 210 TPY of CO_2e (21 x 10 TPY of CH_4) = 660 TPY of CO_2e.

Unit A Three years ago, during the contemporaneous period, there was an emissions increase of 10,000 TPY CO_2 (10,000 TPY CO_2e) from the addition of a new emissions unit (Unit A) at the source. There are no other creditable emissions increases or decreases during the contemporaneous period.

Note: The source must calculate emissions changes from existing emissions units being modified (e.g., Unit #1) and in preparing that calculation, the source must compare the emission unit's baseline actual emissions to either (1) a projection of its future actual emissions; or (2) its potential to emit (PTE). See 40 CFR 52.21(b)(41)(ii). Any creditable emissions decreases from existing emissions units must be decreases in baseline actual emissions. The requirements of the PSD rules apply to these calculations and determinations as applicable.

Mass-Based Calculations

***(Step 1**) In this step, only consider emissions increases of GHGs from the proposed modification.*

Unit #2 77,000 TPY mass emissions **increase** of GHGs.

[134] For the purposes of this example, the Global Warming Potential values are from the 40 CFR Part 98 Table A-1, as of the date of this document.

Unit #1 The proposed GHG emissions are 460 TPY, which is a 40 TPY GHG mass emissions **decrease** from the baseline actual emissions of 500 TPY. The change at Unit #1 results in a **decrease** in GHG emissions and is therefore not considered in Step 1.

Increases = 77,000 TPY GHG mass emissions increase from Unit #2 is greater than zero TPY, so

Go to Step 2 and conduct contemporaneous netting

(Step 2) *In this step, include the emissions increases and decreases of GHGs from the project and all other contemporaneous and creditable emissions increases and decreases of GHGs.*

Net emissions increase = 77,000 TPY GHG mass emissions from Unit #2 minus a 40 TPY GHG decrease from Unit #1 plus a 10,000 TPY GHG increase from Unit A equals 86,960 TPY GHG mass emissions. This net emissions increase is greater than zero TPY, so

Go to the CO_2e*-based calculations*

CO_2e-Based Calculations

(Step 1) *In this step, only consider CO_2e emissions increases from the modification.*

Unit #2 77,000 TPY CO_2e emissions **increase**

Unit #1 The proposed CO_2e emissions after the modification are 660 TPY CO_2e, which is a 1,840 TPY CO_2e **decrease** from baseline actual emissions of 2,500 TPY CO_2e. Since it is a decrease, ignore the change in CO_2e emissions.

Increases = 77,000 TPY CO_2e emissions increase from Unit #2 is equal to or greater than 75,000 TPY CO_2e, so

Go to Step 2 and conduct contemporaneous netting

(Step 2) *In this step, consider all emissions increases and decreases of CO_2e from the proposed project and all other contemporaneous and creditable emissions increases and decreases of CO_2e.*

Net emissions increase = 77,000 TPY CO_2e emissions increase from Unit #2 minus 1,840 TPY CO_2e emissions decrease from Unit #1 plus a 10,000 TPY CO_2e emissions increase from Unit A equals 85,160 TPY CO_2e emissions. This net emissions increase is equal to or greater than 75,000 TPY CO_2e.

Results: The modification is both a "significant emissions increase" (Step 1) and a "significant net emissions increase" (Step 2) in both the mass and CO_2e-based calculations; therefore, the modification as proposed is major and subject to PSD for GHGs.

Appendix F. BACT Example – Natural Gas Boiler

[Disclaimer: The control options listed here and the outcomes of this example are presented for illustrative purposes only. They do not represent any specific guidance or direction from EPA relative to a BACT determination for this type of source.]

Project Scope: The permit applicant is proposing to install, at an existing PSD major source, a new 250 MMBtu/hour natural gas-fired boiler. The project's emissions increase is in excess of 75,000 TPY CO_2e and the permit will be issued in March 2011, so the project is subject to BACT for GHGs under Step 1 of the Tailoring Rule. For the sake of simplicity, this example focuses on the section of the BACT analysis for GHG emissions from the project.

The top-down BACT determination is carried out in the following five steps:

Step 1: Identifying all available controls

For purposes of this example, assume that the permit application listed the following available controls in the GHG BACT analysis:

- Boiler Annual Tune-up – Once a year the boiler is tuned for optimal thermal efficiency.
- Boiler Oxygen Trim Control – Stack oxygen level is monitored and the inlet air flow is adjusted for optimal thermal efficiency.
- Use of an Economizer – A heat exchanger is used to transfer some of the heat from the boiler exhaust gas to the incoming boiler feedwater. Preheating the feedwater in this way reduces boiler heating load, increases its thermal efficiency and reduces emissions.
- Boiler Blowdown Heat Recovery – Periodically or continuously, some water in the boiler is removed as a means of avoiding the build-up of water impurities in the boiler. A heat exchanger is used to transfer some of the heat in the hot blowdown water for preheating feedwater. This increases the boiler's thermal efficiency.
- Condensate Recovery – As the boiler steam is used in the heat exchanger, it condenses. When hot condensate is returned to the boiler as feedwater, the boiler heating load is reduced and the thermal efficiency increases.

As would be appropriate under EPA's guidelines for Step 1 of the BACT process, the permitting authority asked the applicant to expand the analysis to consider an air preheater (which recovers heat in the boiler exhaust gas to preheat combustion air). Accordingly, at this stage in this example, the permit applicant and permitting authority identified six control measures.

Further, a public comment was received arguing that the analysis should include a combined cycle natural gas-fired turbine that is more efficient than the proposed boiler. Since the application explains that a boiler is necessary to fulfill the fundamental business purpose of providing process steam (and not generating electricity) and because a varying steam demand requires the ability to startup and shutdown the boiler quickly (due to the fluctuating operational demands of the facility, as substantiated in the application), the permitting authority declined to list the option in Step 1 of the BACT analysis on the grounds it would redefine the source. The permitting authority thoroughly documented this decision in its response to comments.

Step 2: Eliminating technically infeasible options

At this stage of the review, the permit applicant and the permitting authority examine all options for technical feasibility. For this example, the permitting authority determined that the seven controls identified are technically feasible because nothing in the record showed that any of these options was not demonstrated or available or applicable to this type of source.

Step 3: Evaluation and ranking of controls by their effectiveness.

At this step, the permit applicant and permitting authority need to select a measure of effectiveness to compare and rank the options. Assume in this example that the applicant ranked control measures for the boiler based on their impact on the thermal efficiency of the boiler, after finding that thermal efficiency was a useful indicator of CO_2 control efficiency because fuel use is directly related to CO_2 emissions for the boiler and the impact of control measures.

The permit applicant completed the control effectiveness analysis showing that the most effective single measure is oxygen trim control. The applicant's analysis also showed that the use of an air preheater was no more effective than an economizer in recovering exhaust heat, and so the applicant narrowed the review to the economizer only. In this example, the applicant's analysis next considered the effectiveness of the boiler controls in combinations and found that the most effective combination of measures is the use of four measures – oxygen trim control, an economizer, condensate recovery and blowdown heat recovery – which was approved by the permitting authority.

Step 4: Evaluating the most effective controls and documenting results

In this step, the permit applicant completed an analysis of the cost effectiveness of measures and combinations of measures, expressed as $/ton of GHG reduced, as well as an incremental cost effectiveness analysis. In this example, the applicant found that, given the size and other characteristics of this facility, the packages including boiler blowdown heat recovery was not cost effective (as an incremental measure compared to cost born by similar facilities) and the next most effective combination of measures for the boiler was the use of oxygen trim control, an economizer and condensate recovery. The applicant documented this decision in the permitting record and the permitting authority agreed.

Significant energy and environmental impacts are also considered in this step. In this example, the record also showed that the recovery and reuse of condensate would reduce the use of boiler treatment chemicals and the generation of related waste and thus would reduce the amount of water going to wastewater treatment at the site. Since condensate recovery was still in consideration, this information provided additional record support continuing to consider condensate recovery part of the technology option.

Step 5: Selecting BACT

With the analysis and record complete, the permitting authority determines BACT in this last step. In this example, the permitting authority determined, and the record showed, that BACT for GHGs from the proposed facility was the combination of oxygen trim control, an economizer and condensate recovery for the boiler, along with a high transfer efficiency design for the heat exchanger. Accordingly, the permitting authority included the following permit terms in the permit:

- Emission limit expressed in lbs of CO_2e emissions per pound of steam produced, averaged over 30 day rolling periods;
- CO_2e emissions are to be determined based on metered natural gas use and the application of standard emission factors;
- Steam production determined from a gauge on the outlet of the boiler;
- In addition, there would be a requirement to install the boiler as described in the application and BACT determination;
- There would be a requirement to implement a preventive maintenance program for the air to fuel ratio controller of the boiler; and
- A requirement for periodic maintenance and calibration of the natural gas meter and the steam flow analyzer.

Appendix G. BACT Example – Municipal Solid Waste Landfill

[Disclaimer: The control options listed here and the outcomes of this example are presented for illustrative purposes only. They do not represent any specific guidance or direction from EPA relative to a BACT determination for this type of source.]

Project Scope: The permit applicant proposes to build a new, large municipal solid waste landfill. As the solid waste in a landfill decomposes, landfill gas (composed of methane, carbon dioxide, and trace amounts of organic compounds) is formed. The application shows that the PTE of the landfill expressed as CO_2e emissions is in excess of 100,000 TPY. The permit will be issued after June 2011, so BACT will apply to the GHG emissions under Step 2 of the Tailoring Rule. For the sake of simplicity, this example focuses on the section of the BACT analysis for the capture and control of the landfill gas from the project.

The permit applicant and reviewing authority conduct their BACT determination using the five steps of the top-down processes as follows:

Step 1: Identifying all available controls

The permit applicant and permitting authority agree that the BACT review for a landfill logically has two elements: the capture of the landfill gas and the control of emissions of that gas. In this example, there is an existing NSPS (Part 60 Subpart WWW) applicable to non-methane organic compounds (NMOC) emissions from Municipal Solid Waste (MSW) landfills, which addresses the capture and control of landfill gas. While the NSPS addresses a different component of the emissions than GHGs, the permit applicant and the permitting authority determine that the NSPS is a useful starting point for a GHG BACT determination since it has detailed requirements for the design and operation of the gas collection system.

For capture of the landfill gas, the application uses compliance with the NSPS as the starting point. For control, the applicant identified the following three NSPS options as a starting point for the BACT determination:

- venting to an on-site flare,
- use of the gas in on-site internal combustion engines to generate electricity, or
- treatment of the gas for delivery to a natural gas pipeline.

The applicant did not identify or propose any alternative control options in the application, and none were suggested in public comments. However, the permitting authority did ask the applicant to expand the review to consider two other control measures: (1) a requirement to collect and control landfill gas earlier in the life of the landfill than is specified in the NSPS, and (2) the use of a gas turbine to generate power rather than internal combustion engines.

At this stage, there are two control measures listed for gas capture (NSPS compliant system and a NSPS system with earlier gas collection and treatment) and four control options listed for the control of the landfill gas that is collected (flaring, fueling engines, fueling a gas turbine, and treatment and routing of the gas to a pipeline).

Step 2: Eliminating technically infeasible options

At this stage of the review, the applicant and permitting authority assess the technical feasibility of each option. In this example, the applicant demonstrated that the volume of gas from the proposed facility would be inadequate to fuel a commercially available gas turbine. The permitting authority reviewed the record regarding the technical infeasibility for the gas turbine option, found it was adequate, and accepted elimination of that option from further consideration.

Step 3: Evaluation and ranking of controls by their effectiveness

At this step, the permit applicant and permitting authority need to determine a metric for ranking the control effectiveness of the options under consideration. In this case, the application used total CO_2e emissions over the life of the landfill, based on the current business plan and design, as the effectiveness indicator. The applicant explained that the CO_2e emissions estimates in their application reflected the direct emissions of GHGs and the CO_2 produced for the options where that gas was combusted on site. The application also considered combinations of capture systems and controls for overall effectiveness. The record showed that early capture of gas and conversion of the gas to pipeline quality for export were likely to be the most effective combination, from a PSD perspective, given that the maximum amount of gas would be captured and most of the gas would not be combusted on site. The record also showed that flaring and the use of engines were similar in their control of overall on-site GHG emissions, with both controls reducing methane emissions significantly while generating relatively small on-site CO_2 emissions in the process.

Step 4: Evaluating the most effective controls and documenting results

In this step, the applicant completed an analysis of the cost effectiveness of control measures, expressed as $/ton of GHG reduced, and also determined the incremental cost effectiveness. In this example, the applicant's analysis first found that conversion of gas to pipeline quality was not cost effective, explaining that this control option would more than double the overall cost of the project since the landfill was far from an existing pipeline, and the permitting authority agreed that it should be eliminated for further consideration in the BACT analysis. The record also showed that the NSPS system with early collection was cost effective in both the flare and the engines case. There was also evidence in the record showing that the flare was more cost effective because revenue from the sale of power from use of engines was too little to offset the added cost of the engines and a power transmission line.

The applicant and permitting authority also considered the collateral energy and environmental impacts of the options. In this example, the application noted that there was a positive environmental impact from the use of a flare because NO_X emissions for a flare would be lower than those for the engines. Some public comments identified positive energy and environmental offsite impacts arising from the fact that using landfill gas to generate electricity would displace some other offsite energy generation and associated emissions. In responding to the comments, the permitting authority determined that this benefit outweighed the lower NO_X emissions from the flare. The permit record also demonstrated that the use of engines or a flare would have

nearly equal CO_2e control effectiveness. Accordingly, the permitting authority found that the environmental benefits arising from the engines-based system outweighed the flare's cost effectiveness and environmental benefits of lower NO_X emissions.

Step 5: Selecting BACT

The permitting authority determines BACT in this last step. In this example, the permitting authority determined that BACT for the proposed facility was NSPS compliance with early implementation of the capture and control system with engines combusting the landfill gas to generate electricity. Accordingly, the permitting authority included the following permit terms in the permit:

- Compliance with the landfill design and operation requirements of the applicable NSPS with a revised condition for earlier capture and control of the gas.
- A requirement to combust the collected gas in engines with the creation and use of an O&M plan for the engines to assure that they operate efficiently.

Appendix H. BACT Example – Petroleum Refinery Hydrogen Plant

[Disclaimer: The control options listed here and the outcomes of this example are presented for illustrative purposes only. They do not represent any specific guidance or direction from EPA relative to a BACT determination for this type of source.]

Project Scope:
Petroleum refineries produce and utilize hydrogen in order to convert crude oil to finished products. In this example, a permit applicant proposes a modification project to expand the hydrogen production and hydrotreating capacity of an existing major source refinery. The application submitted by the permit applicant shows that the project has a significant emissions increase and a significant net emissions increase on both a CO_2e basis and a mass basis. The permitting authority will issue the permit in October 2011, so PSD is triggered for GHGs in Step 2 of the Tailoring Rule. For simplicity, this example addresses the GHG BACT analysis for the new hydrogen plant only.

Accordingly to the application, the proposed project utilizes the most common method of producing hydrogen at a refinery, the steam methane reforming (SMR) process. In SMR, methane and steam are reacted via a catalyst to produce hydrogen and CO. The reaction is endothermic and the necessary heat is provided in a gas-fired reformer furnace. The CO generated by the initial SMR reaction further reacts with the steam to generate hydrogen and CO_2. The hydrogen is then separated from the CO_2 and other impurities. In this example, the application shows that the purification is done using a Pressure Swing Adsorption Unit. The permit applicant proposes to use the offgas from that step (containing some hydrogen, CO_2, and other gases) as part of the fuel for the reformer furnace.

The top-down BACT determination is carried out in the following five steps:

Step 1: Identifying all available controls

Assume for purposes of this example that the permit application lists the following control options for GHG emissions:

- Furnace Air/Fuel Control – An oxygen sensor in the furnace exhaust is to be used to control the air and fuel ratio in the furnace on a continuous basis for optimal energy efficiency.
- Waste Heat Recovery – The overall thermal efficiency is to be optimized through the recovery of heat from both the furnace exhaust and the process streams to preheat the furnace combustion air, to preheat the feed to the furnace and to produce steam for use in the process and elsewhere in the refinery.
- CO_2 Capture and Storage – Capture and compression, transport, and geologic storage of the CO_2. (Some refineries isolate hydrogen reformer CO_2 for sale but that is not a part of this example project.)

The permitting authority did not require the applicant to identify any alternative control options beyond those in the application, and none were suggested in public comments.

Step 2: Eliminating technically infeasible options

At this stage of the review, the permit applicant and the permitting authority examine the control options for technical feasibility. In this example, the permitting record shows that all three controls are technically feasible because there is no evidence that any of these options are not demonstrated or available or applicable to this type of source.

Step 3: Evaluation and ranking of controls by their effectiveness.

At this step, the permit applicant and permitting authority need to select a measure of effectiveness to compare and rank the options. In this example, the applicant ranked control measures for the hydrogen plant based on the GHG emissions per unit of hydrogen produced. The applicant and the permitting authority agreed that such an output-based indicator was a good way to capture the overall effect of multiple energy efficiency measures used in the design of a complex process such as this.

The permit applicant then completed a control effectiveness analysis, in which benchmarking data on the energy efficiency and GHG emissions of recently installed hydrogen plants was provided. The applicant showed that by incorporating various heat recovery measures this hydrogen plant would be a lower emitter (on an output basis) than similar new plants, and the permitting authority concurred in that determination. The applicant's analysis considered the effectiveness of each individual measure and combinations of measures. In this case, the applicant determined that the most effective combination was one in which all three options were included.

Step 4: Evaluating the most effective controls and documenting results

In this step, the permit applicant completed an analysis of the cost effectiveness of measures and combinations of measures, expressed as $/ton of GHG reduced. The applicant also determined the incremental cost effectiveness. In this example, the information supplied by the applicant demonstrated that the transport and sequestration of CO_2 would not be cost effective because the nearest prospective location for sequestration was more than 500 miles away and there was not an existing pipeline or other suitable method for CO_2 transport between the refinery and the sequestration location. Accordingly, the record showed that the cost of transport was significant in comparison to the amount of CO_2 to be sequestered and the cost of the project overall. Although the permitting authority affirmed this determination, in responding to public comments on the issue, the permitting authority did note that in circumstances in which a refinery was located near an oil field that used CO_2 injection for enhanced recovery, the cost for transport and sequestration would likely be in a range that would not exclude the transport control option from the list of technologies that would continue to be considered in the BACT analysis.

Permit applicants and permitting authorities also consider other significant energy and environmental impacts in this step. In this case, none were presented in the application, and the only significant public comment on the issue was addressed by the permitting authority, as noted above.

Step 5: Selecting BACT

With the analysis and record complete, the permitting authority determines BACT. In this example, the permitting authority determined that BACT was a combination of furnace combustion control and integrated waste heat recovery. Accordingly, the permitting authority included the following permit terms in the permit:

- Emission limit in pounds of CO_2e emitted per pound of hydrogen produced, averaged over rolling 30-day periods.
- CO_2e emissions would be determined by metering natural gas sent to the hydrogen plant. With prior approval of the permitting authority, the emissions could be adjusted for excess fuel gas sent to other parts of the refinery. A separate meter and fuel analysis would be needed to get that credit.
- Hydrogen production would be metered.
- The heat recovery systems would need to be installed as described in the application.
- There would need to be a written program for calibration and maintenance of meters.

Appendix I. Resources for GHG Emission Estimation

The following are a number of methods that are traditionally used to estimate PTE from sources and relevant emissions units:

- Federally enforceable operational limits, including the effect of pollution control equipment;
- Performance test data on similar units;
- Equipment vendor emissions data and guarantees;
- Test data from EPA documents, including background information documents for new source performance standards, national emissions standards for hazardous air pollutants, and Section 111(d) standards for designated pollutants;
- AP-42 Emission Factors;
- Emission factors from technical literature; and
- State emission inventory questionnaires for comparable sources.

These approaches remain relevant for GHG emissions calculations and serve as the fundamental approaches to estimating emissions for permitting applications. For example, direct measurements methods such as continuous emissions monitors (CEMs) would continue to be a preferred means to form the starting point basis for estimating emissions from GHG emissions units. However, because GHG emissions historically have not been subject to regulation under air permitting programs, and there are unique GHG emission source categories, there is not as widespread representation or long-term experience with GHG estimation techniques and measurement methods as there is for conventional pollutants under the above approaches. The purpose of this section is to identify additional references and resources that may be useful when evaluating GHG emission sources and deciding which estimation methods to use.[135]

Mandatory Reporting of Greenhouse Gases. This final rule was issued on October 30, 2009 (74 FR 56260), and established GHG reporting requirements for all sectors of the economy and should be considered a primary reference for sources and permitting authorities in estimating GHG emissions and establishing measurement techniques when preparing or processing permit applications. The rule includes procedures for estimating GHG emissions from the source categories that are responsible for the majority of stationary source GHG emissions in the U.S. The procedures identify where applications of direct measurement techniques are viable and describes emission factor and mass-balance based approaches where direct measurement techniques are not applicable or available.

[135] The exclusion of a source or emission unit category from these sources does not imply that such sources or emissions units are excluded from permitting requirements. For example, as of the date of this publication CO_2 from biomass combustion is not included in determining applicability under the mandatory reporting rule, but is included in determining applicability under both PSD and title V programs as described in the Tailoring Rule. Also, there are not methods identified for all possible GHG emitting sources and units in the current mandatory reporting rule.

While the GHG reporting rule is focused on estimating and reporting *actual* emissions from source categories, the basic approaches can be used to estimate a source's PTE when correctly adjusted to reflect future conditions and operating parameters. Since many of the affected GHG source categories and emissions units have been or will be subject to permitting requirements for conventional, non-GHG pollutants, sources should use similar adjustments to fuel throughput, activity data, and emissions for determining PTE for GHG that have been used in existing PSD and title V guidance for those units and which are applied on a case-by-case basis depending on specific operating parameters for the affected sources.

Other reference sources that may prove useful to sources and permitting authorities in identifying, characterizing and estimating emissions from GHG emission sources include the following:

- **ENERGY STAR Industrial Sector Energy Guides and Plant Energy Performance Indicators (benchmarks)**
  http://www.energystar.gov/epis

- **US EPA National Greenhouse Gas Inventory**
  http://epa.gov/climatechange/emissions/usinventoryreport.html

- **EPA's Climate Leaders Protocols**
  http://www.epa.gov/stateply/index.html

- **EPA's Voluntary Partnerships for GHG Reductions:**
  - Landfill Methane Outreach Program (http://www.epa.gov/lmop/)
  - CHP Partnership Program (http://www.epa.gov/chp)
  - Green Power Partnership (http://www.epa.gov/greenpower)
  - Coalbed Methane Outreach Program (http://www.epa.gov/cmop/index.html)
  - Natural Gas STAR Program (http://www.epa.gov/gasstar/index.html)
  - Voluntary Aluminum Industrial Partnership: http://www.epa.gov/highgwp/aluminum-pfc/index.html

- **SF Emission Reduction Partnership for the Magnesium Industry**
  http://www.epa.gov/highgwp/magnesium-sf6/index.html

- **PFC Reduction/Climate Partnership for the Semiconductor Industry**
  http://www.epa.gov/highgwp/semiconductor-pfc/index.html

- **Landfill Gas Emissions Model**
  User's Guide: http://www.epa.gov/ttncatc1/dir1/landgem-v302-guide.pdf

- **Estimation Methodologies for Biogenic Emissions from Solid Waste Disposal, Wastewater Treatment, and Ethanol Fermentation**
  http://www.epa.gov/ttn/chief/efpac/ghg/GHG_Biogenic_Report_revised_Dec1410.pdf

Appendix J. Resources for GHG Control Measures

The following are several information sources to consider when looking for available GHG control measures when conducting a BACT analysis.

- **EPA's GHG Mitigation Measures Database**
  http://www.epa.gov/nsr/ghgpermitting.html

- **EPA's Sector GHG Control White Papers**
  http://www.epa.gov/nsr/ghgpermitting.html

- **EPA's RACT/BACT/LAER Clearinghouse (RBLC)**
  http://cfpub.epa.gov/rblc/

- **ENERGY STAR Guidelines for Energy Management**
  http://www.energystar.gov/guidelines

- **ENERGY STAR Industrial Sector Energy Guides**
  http://www.energystar.gov/epis

- **EPA's Climate Leaders Protocols**
  http://www.epa.gov/stateply/index.html

- **Report of the Interagency Task Force on Carbon Capture and Storage**
  http://www.epa.gov/climatechange/policy/ccs_task_force.html

- **EPA's Lean and Energy Toolkit**
  http://www.epa.gov/lean/toolkit/LeanEnergyToolkit.pdf

- **EPA's Voluntary Partnerships for GHG Reductions:**
  - Landfill Methane Outreach Program (http://www.epa.gov/lmop/)
  - CHP Partnership Program (http://www.epa.gov/chp)
  - Green Power Partnership (http://www.epa.gov/greenpower)
  - Coalbed Methane Outreach Program (http://www.epa.gov/cmop/index.html)
  - Natural Gas STAR Program (http://www.epa.gov/gasstar/index.html)
  - Voluntary Aluminum Industrial Partnership:
    http://www.epa.gov/highgwp/aluminum-pfc/index.html

- **SF Emission Reduction Partnership for the Magnesium Industry**
  http://www.epa.gov/highgwp/magnesium-sf6/index.html

- **PFC Reduction/Climate Partnership for the Semiconductor Industry**
  http://www.epa.gov/highgwp/semiconductor-pfc/index.html

- **DOE's Industrial Technologies Program (Best Practices)**
  http://www1.eere.energy.gov/industry/bestpractices/

Additionally, the following are several information sources that may be helpful when including benchmarking as part of a BACT analysis.

- **EPA Energy Star Industrial Energy Management Information Center**
  http://www.energystar.gov/index.cfm?c=industry.bus_industry_info_center

- **DOE Industrial Technologies Program**
  http://www1.eere.energy.gov/industry/

- **Lawrence Berkeley National Laboratory Industrial Energy Analysis Program**
  http://industrial-energy.lbl.gov/

- **European Union Energy Efficiency Benchmarks**
  http://ec.europa.eu/environment/climat/emission/benchmarking_en.htm

In addition to the above sources of information, once permitting authorities gain experience with GHG BACT determinations, useful information on GHG permitting decisions will be present in EPA's RBLC and Control Technology Center.

Appendix K. Calculating Cost Effectiveness for BACT

The following excerpt is from the Draft 1990 NSR Workshop Manual (pages B.36-B.44)

IV.D.2.b. COST EFFECTIVENESS

Cost effectiveness is the economic criterion used to assess the potential for achieving an objective at least cost. Effectiveness is measured in terms of tons of pollutant emissions removed. Cost is measured in terms of annualized control costs.

Cost effectiveness calculations can be conducted on an average, or incremental basis. The resultant dollar figures are sensitive to the number of alternatives costed as well as the underlying engineering and cost parameters. There are limits to the use of cost-effectiveness analysis. For example, cost-effectiveness analysis should not be used to set the environmental objective. Second, cost-effectiveness should, in and of itself, not be construed as a measure of adverse economic impacts. There are two measures of cost-effectiveness that will be discussed in this section: (1) average cost-effectiveness, and (2) incremental cost-effectiveness.

Average Cost Effectiveness

Average cost effectiveness (total annualized costs of control divided by annual emission reductions, or the difference between the baseline emission rate and the controlled emission rate) is a way to present the costs of control. Average cost effectiveness is calculated as shown by the following formula:

$$\text{Average Cost Effectiveness (dollars per ton removed)} = \frac{\text{Control option annualized cost}}{\text{Baseline emissions rate - Control option emissions rate}}$$

Costs are calculated in (annualized) dollars per year ($/yr) and emissions rates are calculated in tons per year (tons/yr). The result is a cost effectiveness number in (annualized) dollars per ton ($/ton) of pollutant removed.

Calculating Baseline Emissions

The baseline emissions rate represents a realistic scenario of upper boundary uncontrolled emissions for the source. The NSPS/NESHAP requirements or the application of controls, including other controls necessary to comply with State or local air pollution regulations, are not considered in calculating the baseline emissions. In other words, baseline emissions are essentially uncontrolled emissions, calculated using realistic upper boundary operating assumptions. When calculating the cost effectiveness of adding post process emissions controls to certain inherently lower polluting processes, baseline emissions may be assumed to be the emissions from the lower polluting process itself. In other words, emission reduction credit can be taken for use of inherently lower polluting processes.

Estimating realistic upper-bound case scenario does not mean that the source operates in an absolute worst case manner all the time. For example, in developing a realistic upper boundary case, baseline emissions calculations can also consider inherent physical or operational constraints on the source. Such constraints should accurately reflect the true upper boundary of the source's ability to physically operate and the applicant should submit documentation to verify these constraints. If the applicant does not adequately verify these constraints, then the reviewing agency should not be compelled to consider these constraints in calculating baseline emissions. In addition, the reviewing agency may require the applicant to calculate cost effectiveness based on values exceeding the upper boundary assumptions to determine whether or not the assumptions have a deciding role in the BACT determination. If the assumptions have a deciding role in the BACT determination, the reviewing agency should include enforceable conditions in the permit to assure that the upper bound assumptions are not exceeded.

For example, VOC emissions from a storage tank might vary significantly with temperature, volatility of liquid stored, and throughput. In this case, potential emissions would be overestimated if annual VOC emissions were estimated by extrapolating over the course of a year VOC emissions based solely on the hottest summer day. Instead, the range of expected temperatures should be considered in determining annual baseline emissions. Likewise, potential emissions would be overestimated if one assumed that gasoline would be stored in a storage tank being built to feed an oil-fired power boiler or such a tank will be continually filled and emptied. On the other hand, an upper bound case for a storage tank being constructed to store and transfer liquid fuels at a marine terminal should consider emissions based on the most volatile liquids at a high annual throughput level since it would not be unrealistic for the tank to operate in such a manner.

In addition, historic upper bound operating data, typical for the source or industry, may be used in defining baseline emissions in evaluating the cost effectiveness of a control option for a specific source. For example, if for a source or industry, historical upper bound operations call for two shifts a day, it is not necessary to assume full time (8760 hours) operation on an annual basis in calculating baseline emissions. For comparing cost effectiveness, the same realistic upper boundary assumptions must, however, be used for both the source in question and other sources (or source categories) that will later be compared during the BACT analysis.

For example, suppose (based on verified historic data regarding the industry in question) a given source can be expected to utilize numerous colored inks over the course of a year. Each color ink has a different VOC content ranging from a high VOC content to a relatively low VOC content. The source verifies that its operation will indeed call for the application of numerous color inks. In this case, it is more realistic for the baseline emission calculation for the source (and other similar sources) to be based on the expected mix of inks that would be expected to result in an upper boundary case annual VOC emissions rather than an assumption that only one color (*i.e.,* the ink with the highest VOC content) will be applied exclusively during the whole year.

In another example, suppose sources in a particular industry historically operate at most at 85 percent capacity. For BACT cost effectiveness purposes (but **not** for applicability), an applicant may calculate cost effectiveness using 85 percent capacity. However, in comparing

costs with similar sources, the applicant must consistently use an 85 percent capacity factor for the cost effectiveness of controls on those other sources.

Although permit conditions are normally used to make operating assumptions enforceable, the use of "standard industry practice" parameters for cost effectiveness calculations (but **not** applicability determinations) can be acceptable without permit conditions. However, when a source projects operating parameters (*e.g.*, limited hours of operation or capacity utilization, type of fuel, raw materials or product mix or type) that are lower than standard industry practice or which have a deciding role in the BACT determination, then these parameters or assumptions must be made enforceable with permit conditions. If the applicant will not accept enforceable permit conditions, then the reviewing agency should use the absolute worst case uncontrolled emissions in calculating baseline emissions. This is necessary to ensure that the permit reflects the conditions under which the source intends to operate.

For example, the baseline emissions calculation for an emergency standby generator may consider the fact that the source does not intend to operate more than 2 weeks a year. On the other hand, baseline emissions associated with a base-loaded turbine would not consider limited hours of operation. This produces a significantly higher level of baseline emissions than in the case of the emergency/standby unit and results in more cost effective controls. As a consequence of the dissimilar baseline emissions, BACT for the two cases could be very different. Therefore, it is important that the applicant confirm that the operational assumptions used to define the source's baseline emissions (and BACT) are genuine. As previously mentioned, this is usually done through enforceable permit conditions which reflect limits on the source's operation which were used to calculate baseline emissions.

In certain cases, such explicit permit conditions may not be necessary. For example, a source for which continuous operation would be a physical impossibility (by virtue of its design) may consider this limitation in estimating baseline emissions, without a direct permit limit on operations. However, the permit agency has the responsibility to verify that the source is constructed and operated consistent with the information and design specifications contained in the permit application.

For some sources it may be more difficult to define what emissions level actually represents uncontrolled emissions in calculating baseline emissions. For example, uncontrolled emissions could theoretically be defined for a spray coating operation as the maximum VOC content coating at the highest possible rate of application that the spray equipment could physically process, (even though use of such a coating or application rate would be unrealistic for the source). Assuming use of a coating with a VOC content and application rate greater than expected is unrealistic and would result in an overestimate in the amount of emissions reductions to be achieved by the installation of various control options. Likewise, the cost effectiveness of the options could consequently be greatly underestimated. To avoid these problems, uncontrolled emission factors should be represented by the highest realistic VOC content of the types of coatings and highest realistic application rates that would be used by the source, rather than by highest VOC based coating materials or rate of application in general.

Conversely, if uncontrolled emissions are underestimated, emissions reductions to be achieved by the various control options would also be underestimated and their cost effectiveness overestimated. For example, this type of situation occurs in the previous example if the baseline for the above coating operation was based on a VOC content coating or application rate that is too low [when the source had the ability and intent to utilize (even infrequently) a higher VOC content coating or application rate].

Incremental Cost Effectiveness

In addition to the average cost effectiveness of a control option, incremental cost effectiveness between control options should also be calculated. The incremental cost effectiveness should be examined in combination with the total cost effectiveness in order to justify elimination of a control option. The incremental cost effectiveness calculation compares the costs and emissions performance level of a control option to those of the next most stringent option, as shown in the following formula:

$$\text{Incremental Cost (dollars per incremental ton removed)} = \frac{\text{Total costs (annualized) of control option - Total costs (annualized) of next control option}}{\text{Next control option emission rate - Control option emissions rate}}$$

Care should be exercised in deriving incremental costs of candidate control options. Incremental cost-effectiveness comparisons should focus on annualized cost and emission reduction differences between **dominant** alternatives. Dominant set of control alternatives are determined by generating what is called the envelope of least-cost alternatives. This is a graphical plot of total annualized costs for a total emissions reductions for all control alternatives identified in the BACT analysis (see Figure B-1).

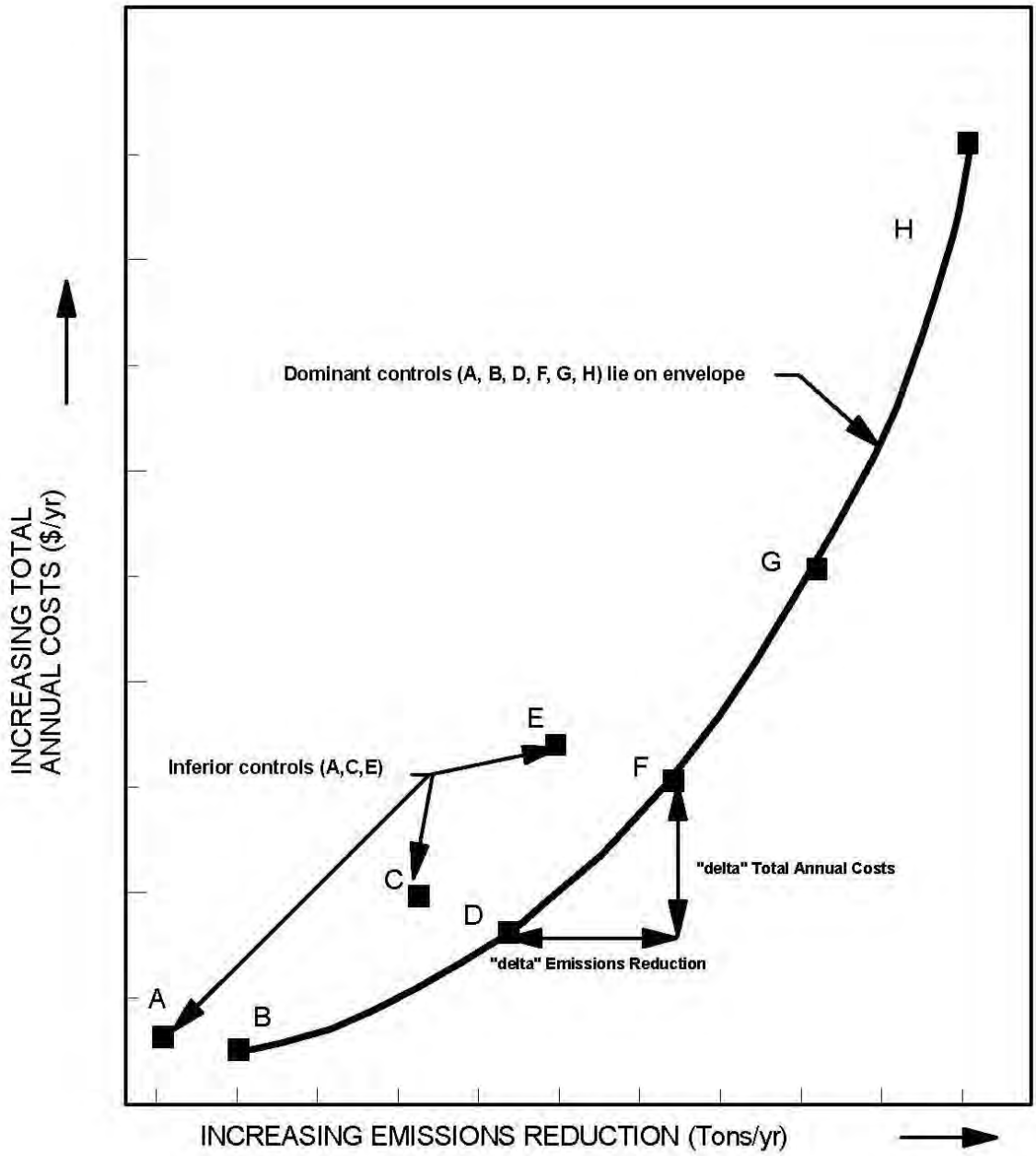


Figure B-1. LEAST-COST ENVELOPE

For example, assume that eight technically available control options for analysis are listed in the BACT hierarchy. These are represented as A through H in Figure B-1. In calculating incremental costs, the analysis should only be conducted for control options that are dominant among all possible options. In Figure B-1, the dominant set of control options, A, B, D, F, G, and H, represent the least-cost envelope depicted by the curvilinear line connecting them. Points C and E are inferior options and should not be considered in the derivation of incremental cost effectiveness. Points A, C and E represent inferior controls because B will buy more emissions reduction for less money than A; and similarly, D and F will by more reductions for less money than E, respectively.

Consequently, care should be taken in selecting the dominant set of controls when calculating incremental costs. First, the control options need to be rank ordered in ascending order of annualized total costs. Then, as Figure B-1 illustrates, the most reasonable smooth curve of the control options is plotted. The incremental cost effectiveness is then determined by the difference in total annual costs between two contiguous options divided by the difference in emissions reduction. An example is illustrated in Figure B-1 for the incremental cost effectiveness for control option F. The vertical distance, "delta" Total Costs Annualized, divided by the horizontal distance, "delta" Emissions Reduced (TPY), would be the measure of the incremental cost effectiveness for option F.

A comparison of incremental costs can also be useful in evaluating the economic viability of a specific control option over a range of efficiencies. For example, depending on the capital and operational cost of a control device, total and incremental cost may vary significantly (either increasing or decreasing) over the operation range of a control device.

As a precaution, differences in incremental costs among dominant alternatives cannot be used by itself to argue one dominant alternative is preferred to another. For example, suppose dominant alternative is preferred to another. For example, suppose dominant alternatives B, D and F on the least-cost envelope (see Figure B-1) are identified as alternatives for a BACT analysis. We may observe the incremental cost effectiveness between dominant alternative B and D is $500 per ton whereas between dominant alternative D and F is $1000 per ton. Alternative D does <u>not</u> dominate alternative F. Both alternatives are dominant and hence on the least cost envelope. Alternative D cannot legitimately be preferred to F on grounds of incremental cost effectiveness.

In addition, when evaluating the total or incremental cost effectiveness of a control alternative, reasonable and supportable assumptions regarding control efficiencies should be made. An unrealistically low assessment of the emission reduction potential of a certain technology could result in inflated cost effectiveness figures.

The final decision regarding the reasonableness of calculated cost effectiveness values will be made by the review authority considering previous regulatory decisions. Study cost estimates used in BACT are typically accurate to ± 20 to 30 percent. Therefore, control cost options which are within ± 20 to 30 percent of each other should generally be considered to be indistinguishable when comparing options.

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