IN RE CARBON INJECTION SYSTEMS, LLC

RCRA Appeal No. 15-01

FINAL DECISION AND ORDER

Decided February 2, 2016

Syllabus

This case presents the question of whether the injection of hydrocarbon materials, such as chemical by-products, into an iron blast furnace brings these materials within the definitions of "solid waste" and "waste" under regulations of the U.S. Environmental Protection Agency and the State of Ohio implementing the Resource Conservation and Recovery Act ("RCRA"), 42 U.S.C. §§ 6901-91. Between 2005 and 2008, Carbon Injection Systems, LLC supplied liquid hydrocarbon materials, allegedly including chemical by-products, for use in an iron blast furnace in Warren, Ohio. EPA Region 5 ("the Region") brought an enforcement action against Carbon Injection Systems charging it and its two owner/operators, Scott Forster and Eric Lofquist, with, among other things, storing and treating hazardous waste without a permit in violation of section 3005 of RCRA, 42 U.S.C. § 6925, and sections 3745-50-40 to 3745-50-66 of the Ohio Administrative Code.

The Region argued that the alleged chemical by-products were "wastes" under the pertinent Ohio regulations, and equivalent EPA regulations, because these hydrocarbon injectants were "recycled" by being "burned to recover energy." The Region contended that the burning of the hydrocarbon injectants produced both needed heat energy and chemical energy necessary to drive chemical reactions in the production of iron. Chief Administrative Law Judge Susan Biro ("ALJ") disagreed that the injectants were "wastes" and dismissed the enforcement action. She concluded that the regulatory phrase "burned to recover energy" only applies to heat energy and does not cover burning to recover chemical energy. Further, the ALJ held that because the injection of hydrocarbon materials has a "cooling effect" in a blast furnace, the hydrocarbon injectants do not provide substantial, useful heat energy to a furnace.

The Environmental Appeals Board ("Board") took the case under *sua sponte* review authority, and requested that the parties address three main issues:

1. Whether the regulatory phrase, "burned to recover energy," includes the recovery of chemical energy as well as heat energy.

2. Whether Carbon Injection Systems had fair notice that the Region's interpretation of the phrase "burned to recover energy" extends to materials burned to recover chemical energy.

3. Whether combusting hydrocarbon injectants within a blast furnace provides substantial, useful heat to the furnace, and thus the injectants qualify as wastes because they are recycled by burning for energy recovery.

Held: The ALJ erred in dismissing the enforcement action. However, because of the particular circumstances of the case, we dismiss on other grounds rather than remand the matter. The Board's findings on the *sua sponte* review issues follow:

1. Although the phrase "burned to recover energy" is not limited by its plain language to burning to recover heat energy alone, EPA has consistently interpreted the phrase to be restricted in this manner.

The phrase "burned to recover energy" was drafted with broad and expansive language. Both standard and scientific dictionary definitions of the term "energy" define it as "the capacity to do work," and mention multiple forms of energy including chemical energy, electrical energy, radiant energy, nuclear energy, and heat energy. The term "burn" can mean "to consume as fuel" or "to transform by the controlled action of fire or heat." Given these definitions, the Board concludes that the plain meaning of the phrase "burned to recover energy" does not preclude reading the phrase to include the burning of materials to use the materials' chemical energy. The ALJ erred in concluding that the plain meaning of a term is limited to the most common example of the term, and in relying on an ironmaking expert's testimony on what a layperson commonly thinks of as "energy."

EPA's consistent interpretation of the phrase "burned to recover energy" is that a material is burned for energy recovery only when combusting it yields "substantial, useful heat." The EPA Administrator first announced this interpretation in the preamble to a 1985 rulemaking implementing administrative controls on waste materials that are recycled by burning for energy recovery. Despite full knowledge that combusted materials can provide both chemical and heat energy, EPA expressly stated that such materials only qualified as "burned to recover energy" because they produced substantial, useful heat. EPA has repeated this interpretation in a RCRA guidance manual that has been frequently republished over the last 20 years. Further, when an associate of Carbon Injection Systems sought clarification from the Region concerning the regulatory status of hydrocarbon injectants, the Region explained that such injectants were "wastes" because they are burned to recover heat energy.

2. Carbon Injection Systems lacked fair notice that the Region interpreted the phrase "burned to recover energy" as covering burning to recover chemical energy.

Due process requires that administrative agencies provide fair notice to the regulated community of its obligations under agency regulations. Absent such fair notice, an agency may not hold a party liable for a regulatory violation. In resolving fair notice claims, our cases apply an "ascertainable certainty" test: "the question is not whether a regulation is susceptible to only one possible interpretation, but rather, whether the particular interpretation advanced by the regulator was ascertainable by the regulated community."

At the time of the alleged regulatory violations, Carbon Injection Systems could not have ascertained the Region's new interpretation of the phrase "burned to recover energy" as including burning to recover chemical energy. Although the plain language does not bar EPA from interpreting "burned to recover energy" as including chemical energy, EPA's authoritative announcement of its interpretation of the regulatory language in the 1985 preamble and frequent republication of that interpretation in guidance documents put regulated parties on notice that EPA construed the phrase "burned to recover energy" as limited to burning to recover heat energy. In these circumstances, the Region may not prosecute Carbon Injection Systems on the theory that its hydrocarbon injectants were wastes because they were recycled by burning for the recovery of chemical energy.

3. Hydrocarbon injectants provide substantial, useful heat when combusted in a blast furnace and therefore qualify as a "waste."

In the preamble to the 1985 rule, the EPA Administrator responded to comments arguing that a hydrocarbon injectant, Cadence product 312, is not "burned to recover energy" when used in a blast furnace. After closely considering the matter, the Administrator concluded that hydrocarbon injectants with substantial heating value supply substantial, useful heat to a blast furnace upon combustion in the furnace. The Administrator explicitly rejected the argument that hydrocarbon injectants do not supply heat energy because they have a net cooling effect on a blast furnace.

In the present case, Carbon Injection Systems was under contract to supply hydrocarbon injectants with an even greater heating value than the Cadence product. Carbon Injection Systems has not established any significant differences between the use of the Cadence product and the circumstances surrounding its provision of hydrocarbon injectants to the WCI Steel blast furnace. Thus, the present case cannot be distinguished from the Administrator's determination on the Cadence product.

There is no reason to reconsider the Administrator's prior determination that hydrocarbon injectants provide substantial, useful heat. The ALJ justified departing from the Administrator's determination both based on the net cooling effect of hydrocarbon

injectants on a blast furnace, and testimony by a Carbon Injection Systems expert concerning a new understanding of blast furnace operations since the Administrator's Cadence determination was announced. However, neither the ALJ nor Carbon Injection Systems offered a convincing reason for putting decisive reliance on a factor – the "net" impact of hydrocarbon injectants on a blast furnace – that the Administrator had previously rejected as irrelevant. Moreover, the evidence presented by both parties corroborates, rather than undermines, the Administrator's prior determination that hydrocarbon injectants with substantial heating value supply substantial, useful heat to a blast furnace. Hydrocarbon injectants play an important role in heating their combustion products at least partially up to the high temperature that is pre-existing in a blast furnace. The evidence also persuasively explains how hydrocarbon injectants can add this substantial, useful heat while simultaneously cooling blast furnace temperatures. Accordingly, the Board finds that the ALJ erred by dismissing this enforcement action on the ground that hydrocarbon injectants are not "wastes" under the Ohio Administrative Code.

The ALJ also erred by examining de novo the question of whether hydrocarbon injectants with substantial heating value are burned for energy recovery. The Board, which has been delegated the Administrator's final decisionmaking authority in adjudicatory matters, gives substantial respect to prior authoritative decisions of the Administrator. Interpretations issued by the Administrator in rulemaking preambles are authoritative. ALJs have not been delegated the Administrator's final decisionmaking authority, but rather issue what are essentially recommended decisions for the Board. Thus, ALJs do not have greater authority than the Board in re-examining authoritative decisions of the Administrator.

Although the ALJ erred in dismissing this case, the Board has determined that a remand is not appropriate here based on the following factors: the Board reviewed this case under its *sua sponte* authority, not on appeal from the Region; the time the case has been pending; and the Region's argument to the Board that hydrocarbon injectants do not provide substantial, useful heat when combusted in a blast furnace coupled with its adoption of the incorrect net heat standard. The Board is charged with operating in a "separate and distinct" role from the Agency's enforcement authority. It would be inappropriate for the Board to revive a dismissed action against regulated parties when the Agency's prosecuting arm has conceded the most critical aspect of the case. Accordingly, taking into account all of these factors, but particularly the Region's concession on the substantial, useful heat question and its adoption of the incorrect standard, we are taking the relatively atypical – but appropriate -- step of not remanding this case to the ALJ, and instead vacating the Initial Decision and dismissing on other grounds.

Before Environmental Appeals Judges Leslye M. Fraser, Kathie A. Stein, and Mary Beth Ward.

Opinion of the Board by Judge Fraser:

I. *INTRODUCTION*

This case presents the question of whether the injection of hydrocarbon materials, such as chemical by-products, into an iron blast furnace brings these materials within the definitions of "solid waste" and "waste" under regulations of the U.S. Environmental Protection Agency and the State of Ohio implementing the Resource Conservation and Recovery Act ("RCRA"), 42 U.S.C. §§ 6901-91. *See* 40 C.F.R. § 261.2; Ohio Admin. Code 3745-51-02. Between 2005 and 2008, Carbon Injection Systems, LLC supplied liquid hydrocarbon materials, allegedly including chemical by-products, for use in an iron blast furnace in the town of Warren, Ohio. EPA Region 5 ("the Region") brought an enforcement action against Carbon Injection Systems charging it and its two owner/operators, Scott Forster and Eric Lofquist, with, among other things, storing and treating hazardous waste without a permit in violation of section 3005 of RCRA, 42 U.S.C. § 6925,

and rules 3745-50-40 to 3745-50-66 of the Ohio Administrative Code.[1] The Region argued that the alleged chemical by-products were "wastes" under the pertinent Ohio regulations, and equivalent EPA regulations, because they were "recycled" by being "burned to recover energy." Initial Decision ("Init. Dec.") at 27. Chief Administrative Law Judge Susan Biro ("ALJ") dismissed the enforcement action, concluding that hydrocarbon injectants are not burned for the recovery of heat energy in a blast furnace. *Id*. at 82-83. We took the case under our *sua sponte* review authority, 40 C.F.R. § 22.30(b), and now vacate the ALJ's decision; however, because of the particular circumstances of the case, we dismiss on other grounds rather than remand the matter to the ALJ.

Both Ohio's and EPA's RCRA regulations define "wastes" (Ohio) and "solid wastes" (EPA) as including, among other things, certain designated used materials, such as sludges and by-products, which are "recycled" by being "burned to recover energy." Ohio Admin. Code 3745-51-20(C); 40 C.F.R. § 261.2(c). In the evidentiary hearing before the ALJ, the Region argued that a hydrocarbon material injected into a blast furnace can qualify as a "recycled" "waste" because combusting such materials releases both needed heat energy and chemical energy. Init. Dec. at 30. The ALJ rejected the argument that "burned to recover energy" includes the recovery of *chemical* energy, finding this interpretation inconsistent with both the plain meaning of the term "energy," and EPA's longstanding interpretation that this phrase only means burning to recover *heat* energy. *Id*. at 47. The ALJ further held that the Region had not shown that the hydrocarbon materials injected into a blast furnace were "burned to recover [heat] energy" because the

[1] The State of Ohio's hazardous waste management regulations govern this enforcement action. State hazardous waste programs that EPA authorizes to administer the RCRA hazardous waste requirements operate "in lieu of the Federal program." 42 U.S.C. § 6926(b). Ohio's hazardous waste program has received final RCRA authorization, 40 C.F.R. § 272.1800(a), and its regulations have been codified as part of the hazardous program under RCRA, *id.* § 272.1801(a)(1). Ohio's regulations defining "discarded material' are substantively identical to EPA's regulations. *Compare* Ohio Admin. Code 3745-51-02 *with* 40 C.F.R. § 261.2. One minor non-substantive distinction between Ohio's and EPA's regulations is that Ohio designates RCRA "solid waste" as merely "waste." *See* Ohio Admin. Code 3745-51-02(A)(1). In its approval of Ohio's program, EPA retained its ability to exercise its enforcement authorities under sections 3007, 3008, 3013, and 7003 of RCRA, 42 U.S.C. §§ 6927, 6928, 6934, and 6973. 40 C.F.R. § 272.1800(c).

Region failed to prove that the materials provided "substantial, useful heat" to the furnace. *Id*. at 82-83. Specifically, the ALJ concluded that although "injectants may release heat energy upon combustion in a blast furnace[,] * * * they do not, in fact, function as a 'fuel' in the traditional sense because of their net consumption of energy and consequential cooling effect in the raceway." *Id*.

In taking *sua sponte* review, we requested that the parties address three main issues:

1. Whether the regulatory phrase, "burned to recover energy," includes the recovery of chemical energy as well as heat energy.
2. Whether Carbon Injection Systems had fair notice that the Region's interpretation of the phrase "burned to recover energy" extends to materials burned to recover chemical energy.
3. Whether combusting hydrocarbon injectants within a blast furnace provides substantial, useful heat to the furnace, and thus the injectants qualify as wastes because they are recycled by burning for energy recovery.

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As explained in detail below, the Board concludes that given the broad meaning of the terms in the regulatory phrase "burned to recover energy," the phrase can potentially be read more expansively than pertaining only to the recovery of heat energy. Thus, the ALJ erred in holding that the plain language of the regulation excludes the recovery of chemical energy. However, we also conclude that Carbon Injection Systems did not have fair notice of the Region's interpretation of "burned to recover energy" as extending to the recovery of chemical energy. In 1985, the EPA Administrator interpreted the phrase "burned to recover energy" as applying only to the recovery of heat energy. Burning of Waste Fuel and Used Oil Fuel in Boilers and Industrial Furnaces, 50 Fed. Reg. 49,164, 49,166-73 (Nov. 29, 1985) [hereinafter *1985 Burning of Waste Fuel Rule*]. The Agency has repeatedly republished that interpretation in guidance documents, including documents released after this enforcement action began. *See, e.g*., U.S. EPA, EPA530-R-06-003, *RCRA Orientation Manual* D-2 (Jan. 2003); U.S. EPA, EPA530-F-11-003, *RCRA Orientation Manual 2014* C-2 (Oct. 2014). Accordingly, the Board holds that the Region cannot prosecute *this* enforcement action under its new reading of the regulation. Conversely, prosecuting this enforcement action under the theory that hydrocarbon injectants provide

substantial, useful heat to a blast furnace poses no fair notice issue given EPA's longstanding interpretation.

Finally, we conclude that the burning of hydrocarbon injectants with substantial heating value in blast furnaces provides substantial, useful heat, and thus such injectants can qualify as solid wastes/wastes. The EPA Administrator answered this question affirmatively in the preamble to the *1985 Burning of Waste Fuel Rule* for a hydrocarbon blast furnace injectant with a lower heating value than the hydrocarbon injectants at issue in this case. In making that determination, the Administrator took into account that hydrocarbon injectants have a cooling effect on furnace temperatures but concluded nonetheless that such injectants supply substantial, useful heat to the furnace. 50 Fed. Reg. 49,164, 49,171-74. The record before us does not provide a valid basis for distinguishing the Administrator's prior determination on this key issue. To the contrary, the higher heat energy provided by Carbon Injection Systems' injectants render that determination controlling here.

Further, nothing in the record leads us to reconsider the Administrator's determination on the heat contribution of hydrocarbon injectants to blast furnaces. The ALJ justified departing from the Administrator's determination both based on hydrocarbon materials' net cooling effect on blast furnace temperatures, and testimony by a Carbon Injection Systems expert concerning a new understanding of blast furnace operations since the promulgation of the *1985 Burning of Waste Fuel Rule*. Yet the evidence presented in these proceedings by both parties corroborates, rather than undermines, the Administrator's determination that hydrocarbon injectants with substantial heating value supply substantial, useful heat to a blast furnace. The evidence also persuasively explains how hydrocarbon injectants can add this substantial, useful heat while simultaneously cooling blast furnace temperatures. Accordingly, the Board finds that the ALJ erred by dismissing this enforcement action on the ground that hydrocarbon injectants are not "wastes" under the Ohio Administrative Code.

Typically, the Board's conclusion that an ALJ erred in dismissing a case would lead us to reverse the ALJ's decision and remand the case to the ALJ to resolve any remaining issues, including assessing a penalty, if appropriate. However, due to the particular circumstances in this case, as discussed in Section VI below, we vacate the ALJ's decision and dismiss the case on different grounds.

II. *STATUTORY AND REGULATORY HISTORY*

RCRA establishes a "cradle to grave" regulatory scheme for hazardous waste, including certain recycled materials, "so as to minimize the present and

future threat to human health and the environment." 42 U.S.C. § 6902(b). Congress and EPA have recognized that "recyclable materials can themselves, if improperly managed, present significant risks to public health and the environment." *In re Howmet Corp.*, 13 E.A.D. 272, 286 (EAB 2007), *aff'd*, 614 F.3d 544 (D.C. Cir. 2010). EPA has explained that treating recycled materials as potentially hazardous wastes "fully agrees with the statute's paramount policy objective: to control the management of hazardous waste from its generation to its final disposition." Identification and Listing of Hazardous Waste, 48 Fed. Reg. 14,472, 14,473 (Apr. 4, 1983). The Board construes RCRA regulations with an eye to this "broad remedial purpose." *See In re S. Timber Prod., Inc.*, 3 E.A.D. 880, 902 (CJO 1992) (holding that RCRA regulations "should be given as broad a reading as is reasonable to effect the remedial purpose of RCRA"); *In re Am. Cyanamid Co.*, 3 E.A.D. 45, 46 (Adm. 1989) (relying on "RCRA's broad remedial purpose" in approving the scope of RCRA permit); *In re Navajo Ref. Co.*, 2 E.A.D. 835, 837 (Adm'r 1989) (rejecting an interpretation of RCRA that "would undermine the broad remedial purpose of RCRA § 3004(u)").

Whether any particular recycled material comes within RCRA's coverage turns on the inter-related statutory terms "hazardous waste," "solid waste," and "discarded material." *See Am. Petroleum Inst. v. EPA*, 906 F.2d 729, 740-41 (D.C. Cir. 1990); *Howme*t, 13 E.A.D. at 275-76. RCRA imposes obligations on persons generating, transporting, treating, storing, or disposing of "hazardous waste." *See* 42 U.S.C. §§ 6921-6925. "Hazardous waste" is defined as a "solid waste" having certain named hazardous characteristics or posing a human health or environmental hazard when improperly treated, stored, transported, disposed of, or otherwise managed. 42 U.S.C. § 6903(5). Thus, only materials that are "solid wastes" can qualify as a RCRA "hazardous waste." RCRA defines "solid waste" as "any garbage, refuse, sludge from [from various pollution treatment facilities] and *other discarded material*, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations." *Id*. § 6903(27) (emphasis added).

EPA and Ohio have extensive regulations further defining what qualifies as a "solid waste," or "waste," the equivalent term used by Ohio. These regulations also expand on the term "other discarded material." In pertinent part, these regulations state that "a discarded material" includes (1) any material that is "abandoned" by being "disposed of" or "burned or incinerated," 40 C.F.R. § 261.2(b)(1)-(2); Ohio Admin. Code 3745-51-02(A)(2), (B), and (2) certain used materials (*e.g.*, spent materials, sludges, and by-products) that are "recycled" by being "burned to recover energy" or "used to produce a fuel, or are otherwise

contained in fuels," 40 C.F.R. § 261.2(c); Ohio Admin. Code 3745-51-02(C).[2] The regulations exclude from the definition of a "solid waste/waste" materials that are recycled through certain types of use or reuse, such as materials that are used or reused as "ingredients in an industrial process," but this exclusion does not apply to materials that are burned for energy recovery. 40 C.F.R. § 261.2(e); Ohio Admin. Code 3745-51-02(E). Under the regulations, a respondent in an enforcement proceeding bears the burden of showing that this or other exclusions from the definition of "solid waste/waste" apply. 40 C.F.R. § 261.2(f); O.A.C. 3745-51-02(F). The regulations also require that respondents seeking to establish an exclusion from the definition of "solid waste/waste" must show that "there is a known market or disposition for the material." 40 C.F.R. § 261.2(f); O.A.C. 3745-51-02(F). To make such a showing, a respondent "must provide appropriate documentation (such as contracts showing that a second person uses the material as an ingredient in a production process)." 40 C.F.R. § 261.2(f); O.A.C. 3745-51-02(F).

EPA's initial set of RCRA regulations excluded from the definition of "solid waste" materials "being burned as fuel for the purpose of recovering usable energy". 40 C.F.R. § 261.2(c)(2) (1981). In 1983, EPA proposed to expand the definition of "solid waste" to include recycled materials "burned to recover energy." 48 Fed. Reg. at 14,485. EPA reasoned that "using or reusing wastes * * * by burning them for energy recovery may present the same sorts of hazards as actually incinerating or disposing of them." *Id*. at 14,474. EPA noted that "recycling operations account for some of the most notorious hazardous waste damage incidents," and such incidents have led to "contamination of soil, ground water, surface water, and air." *Id*. Before EPA finalized these regulations, Congress confirmed the importance of regulating wastes burned for energy recovery under RCRA in the Hazardous and Solid Waste Amendments of 1984. Those amendments required EPA to promulgate standards to protect human health and the environment applicable to "owners and operators of facilities which burn, for purposes of energy recovery," fuels derived from hazardous waste. 42 U.S.C. § 6924(q)(1)(B). Shortly thereafter, on January 4, 1985, EPA finalized its proposal expanding the definition of "solid waste" to include recycled materials "burned to recover energy." Definition of Solid Waste, 50 Fed. Reg. 614, 618 (Jan. 4, 1985). Later that year in the *1985 Burning of Waste Fuel Rule*, EPA established

[2] The term "recycled" also includes certain materials that are "used in a manner constituting disposal," "reclaimed," or "accumulated speculatively." 40 C.F.R. § 261.2(c); Ohio Admin. Code 3745-51-02(C).

administrative controls for persons who market or burn hazardous wastes and used oil fuels. 50 Fed. Reg. at 49,164. The preamble to that rule contains an extended discussion on the meaning of the phrase "burned to recover energy," and specifically finds that hydrocarbon injectants with substantial heating value that are used in blast furnaces are materials that are burned for energy recovery. *Id*. at 49,166-67, 49,171-74.

III. *FACTS*

Scott Forster and Eric Lofquist established Carbon Injection Systems, LLC, in August 2004. Init. Dec. at 13. On January 1, 2005, Carbon Injection Systems contractually agreed to supply WCI Steel, Inc., with "Fuel Oil" as a "fuel alternative to coke and or natural gas" for use in WCI Steel's iron blast furnace in Warren, Ohio. *Id*. at 14; Product and Supply Agreement, CX 24 at EPA-13139.[3] "Fuel Oil" is defined under the contract as "[r]ecycled oil" complying with designated specifications, including that the oil have a British Thermal Unit ("BTU")[4] value between 18,000 and 20,000 BTUs per pound ("BTUs/lb").[5] Product and Supply Agreement, CX 24 at EPA-13139. The contract with WCI Steel also established a sliding pay scale tied to the number of gallons of oil supplied to the furnace. Different per gallon payment amounts were set in 150,000 gallon increments ranging from 0 to 1,050,000 gallons. The contract also specified that WCI Steel would pay Carbon Injection Systems a fixed monthly fee whenever WCI Steel used fewer than 900,000 gallons per month.

To meet its obligation to supply recycled oil to WCI Steel, Carbon Injection Systems used a storage facility it had constructed on property adjacent to the WCI Steel blast furnace. Init. Dec. at 14. Between 2005 and 2008, Carbon Injection Systems purchased and supplied to its facility a total of 55 to 60 million gallons of liquid hydrocarbon materials. *Id*. These materials were initially off-loaded into ten

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[3] Before the ALJ, the complainant's exhibits were abbreviated "CX" and respondents' exhibits were abbreviated "RX." The Board maintains that notation.

[4] A BTU is a unit of heat defined as "[t]he quantity of heat required to raise the temperature of 1 pound of water 1 degree F[ahrenheit] (usually 39 to 40 F). This is the accepted unit for the comparison of heating values of fuels." *Hawley's Condensed Chemical Dictionary* 188 (15th ed. 2007) [hereinafter *Hawley's Dictionary*].

[5] The specifications sheet calls for oil within a range of 135,000 to 150,000 BTUs per gallon and specifies that a gallon weighs 7.5 pounds.

vertical above-ground storage tanks. The materials were blended in another tank, and then Carbon Injection Systems fed the "Fuel Oil" from the mixing tank directly into the WCI Steel blast furnace. *Id*. at 14-15.

The Region alleged that some portion of these hydrocarbon materials supplied to WCI Steel came within the categories of used materials designated by Ohio and EPA regulations as constituting a waste/solid waste if "recycled" by being "burned to recover energy." Complainant's Initial Post-[ALJ] Hrg. Brf. at 15 (redacted version) ("Region 5's Init. Post-[ALJ] Hrg. Brf."). Specifically, the Region alleged that Carbon Injection Systems received the following used materials: (1) K022, a listed hazardous waste[6] defined as "[d]istillation bottom tars from the production of phenol/acetone from cumene," 40 C.F.R. § 261.32(a), and (2) a by-product or process residue from the distillation of flavors and fragrances.[7] *See* Region 5's Init. Post-[ALJ] Hrg. Brf. at 15-39. Cumene is a constituent of crude oil and finished fuels and is used as a thinner for paints, lacquers, and enamels. EPA, Cumene, http://www.epa.gov/ttnatw01/hlthef/cumene.html. *Hawley's Condensed Chemical Dictionary* describes cumene as a toxic, combustible, colorless solvent used in the production of phenol, acetone, and α-methyl-styrene. *Hawley's Condensed Chemical Dictionary* 350 (15th ed. 2007) [hereinafter *Hawley's Dictionary*].

Carbon Injection Systems did not apply for nor receive a permit from the State of Ohio to treat, store, or dispose of hazardous waste at this facility. Joint Stipulations as to Facts, Exhibits and Testimony, Schedule A at 6, ¶ 12 (redacted version). Based on the "Fuel Oil" supplied to WCI Steel, Carbon Injection Systems

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[6] Under EPA's RCRA regulations, EPA may identify solid wastes as hazardous wastes either by "listing" them in the Code of Federal Regulations or by determining that the solid wastes exhibit at least one of four characteristics defined in 40 C.F.R. Part 261 subpart C. The criteria for identifying "characteristic" hazardous wastes and for listing of hazardous wastes are specified in sections 261.10 and 261.11 of Title 40 of the Code of Federal Regulations.

[7] Carbon Injection Systems disputed whether these materials were "hazardous wastes." Respondents Carbon Injection Systems LLC, Scott Forster and Eric Lofquist's Initial Joint Post-[ALJ] Hrg. Brief at 33-56 (redacted version). The ALJ did not reach the question of whether Carbon Injection Systems' injectants contained hazardous waste given her finding that the Region had not shown that hydrocarbon injectants are a solid waste/waste under EPA and Ohio RCRA regulations.

claimed an alternative fuel mixture tax credit on its federal income taxes for the years 2007 through 2009 totaling approximately $10 million. Init. Dec. at 65.

On May 14, 2011, the Region filed a complaint against Carbon Injection Systems, Scott Forster, and Eric Lofquist charging them with storing and treating hazardous waste without a permit and associated violations. Complaint at 8-18, ¶¶ 49-96. The ALJ held an evidentiary hearing on the Region's charges from June 18-29, 2012. On March 17, 2015, the ALJ issued the Initial Decision dismissing the case. The Region did not appeal that decision to the Board. We elected to exercise *sua sponte* review on May 18, 2015, and heard oral argument on October 1, 2015.

IV. *STANDARD OF REVIEW*

The Board reviews an ALJ's Initial Decision on a de novo basis. *See* 40 C.F.R. § 22.30(f) (providing that, in an enforcement proceeding, the Board "shall adopt, modify, or set aside the findings of fact and conclusions of law * * * contained in the decision or order being reviewed"); *see also* Administrative Procedure Act, 5 U.S.C. § 557(b) ("On appeal from or review of [an] initial decision, the agency has all the powers which it would have in making the initial decision except as it may limit the issues on notice or by rule."). This de novo review applies to the ALJ's factual findings, including findings based on expert testimony, as well as legal conclusions. If the ALJ's findings are based on witness credibility determinations from the "observation of witnesses," however, the Board generally defers to such determinations. *See In re Smith Farms Enter., LLC*, 15 E.A.D. 222, 229 (EAB 2011); *In re Ocean State Asbestos Removal, Inc.*, 7 E.A.D. 522, 530 (EAB 1998).

In the proceeding below, the ALJ heard expert testimony from multiple witnesses on the chemical and thermodynamic reactions that take place in an iron blast furnace, as well as on the operations of such blast furnaces. The ALJ, however, did not indicate that she based her findings on credibility determinations from her observation of their respective testimonies; rather, the Initial Decision shows that the ALJ based her findings on the background expertise of the witnesses and her judgment concerning the persuasiveness of the substance of their testimony. Init. Dec. at 48-53 n.30, 68-70, 71, 78. Thus, we find no reason to defer to the ALJ's technical findings on the operation of a blast furnace.

All matters in controversy must be established by a preponderance of the evidence. 40 C.F.R. § 22.24(b). The complainant (here, the Region) has the burdens of presentation and persuasion to prove that "the violation occurred as set

forth in the complaint and that the relief sought is appropriate." *Id.* § 22.24(a). Once the complainant meets this burden, the respondent (here, Carbon Injection Systems) has "the burden of presenting any defense to the allegations set forth in the complaint," and "the burdens of presentation and persuasion for any affirmative defenses." *Id.*; *see also In re Gen. Motors Auto.*, 14 E.A.D. 1, 54-55 (EAB 2008) (describing burden of proof for affirmative defenses).

In this case, an element of the violation is showing that the hydrocarbon materials were a "waste" under the Ohio Administrative Code. Accordingly, the Region bore the burden of proof on this issue. The Region pled and prosecuted its case on the theory that the hydrocarbon materials were wastes because they were "recycled materials" that were "burned to recover energy." Complaint at 5, ¶ 28; Init. Dec. at 27. Thus, the Region bore the burden of showing the hydrocarbon materials were burned for energy recovery.[8]

[8] The ALJ stated that Carbon Injection Systems would bear the burden of proving that its injectants were not burned for energy recovery under the recycling exemption in 40 C.F.R. § 261.2(e) and Ohio Admin. Code 3745-51-02(E), "only *after* Complainant [the Region] has met its burden of demonstrating that the injectants supplied by Respondent CIS did, in fact, supply substantial and useful heat energy to the blast furnace at the WCI Steel Facility upon combustion." Init. Dec. at 48 n.29. The burden of proof on the "burned to recover energy" issue would have been different had the Region pled this case in the alternative: alleging that the hydrocarbon injectants qualified as "wastes" because they either (1) were abandoned by being "burned or incinerated;" 40 C.F.R. § 261.2(b); Ohio Admin. Code 3745-51-02(B), or (2) were recycled by being "burned to recover energy." 40 C.F.R. § 261.2(c); Ohio Admin. Code 3745-51-02(C). In these circumstances, Carbon Injection Systems' assertion of the recycling exclusion for materials "reused as ingredients in an industrial process to make a product" as a defense to a claim that the injectants were abandoned by burning would have placed the burden on Carbon Injection Systems to prove the elements of the exclusion. *See* 40 C.F.R. § 261.2(e), (f); Ohio Admin. Code 3745-51-02(E), (F). The ALJ should also have noted in regard to this exemption that a respondent claiming that a material is excluded from the definition of a "waste," must demonstrate that there is a known market or disposition for the material," as set forth in 40 C.F.R. § 261.2(f) and Ohio Admin. Code 3745-51-02(F). *See* Init. Dec. at 48-52 n.30 (discussing only rule Ohio Admin. Code 3745-51-02(E) and not Ohio Admin. Code 3745-51-02(F)).

V. *ANALYSIS*

A. *Introduction*

We took *sua sponte* review to consider how the ALJ resolved the legal question of whether the regulatory phrase "burned to recover energy" includes chemical energy, and the mixed law-fact question of whether the hydrocarbon materials injected into the WCI Steel blast furnace were "burned to recover energy." Both of these questions have important consequences for the scope of the RCRA hazardous waste management program and thus warrant *sua sponte* review. Additionally, *sua sponte* review is appropriate here because the Initial Decision took the unprecedented step of essentially reversing a determination by the EPA Administrator. We discuss these issues after first providing background information on ironmaking and modern iron blast furnaces.

B. *Ironmaking and the Modern Iron Blast Furnace*

Modern iron blast furnaces are large and technologically sophisticated structures that are intended "to chemically reduce and physically convert iron oxides [i.e., iron ore] into liquid iron called 'hot metal.'" American Iron and Steel Institute, *How a Blast Furnace Works*, http://www.steel.org/making-steel/how-its-made/processes/how-a-blast-furnace-works.aspx, CX 86 at EPA-18464 [hereinafter *How a Blast Furnace Works*]. [9] Humans have smelted iron from iron ore ever since it was discovered thousands of years ago that when "iron-bearing ore [is] heated strongly in contact with hot carbon, out of contact with oxygen, [it] would result in the reduction of iron oxide to iron." The Association of Iron and Steel Engineers Steel Foundation, *The Making, Shaping and Treating of Steel:*

[9] The background information in this section is mostly drawn from this American Iron and Steel Institute paper, which witnesses from both the Region and Carbon Injection Systems endorsed as providing accurate introductory information on the working of a blast furnace. ALJ Hearing Transcript ("ALJ Tr.") at 1091 (testimony of Dr. Fruehan); Frederick C. Rorick, *Technical Report on Blast Furnace Issues in the Matter of Carbon Injection Systems, LLC, et al., Docket No. RCRA-05-2011-0009* (undated), RX 108 at CIS02027 (noting that the American Iron & Steel Institute paper was attached to the Report to provide a "more substantial explanation" of blast furnace operation) [hereinafter *Technical Report on Blast Furnace Issues*].

Ironmaking Volume 3 (11th ed. 1999) [hereinafter *Ironmaking Volume*].[10] Blast furnaces today function on this same principle.

Modern blast furnaces are described as "counter-current" reactors because they do not function in strictly a linear fashion, but rather solids descend from the top of the furnace and gases ascend from the bottom. The solids and gases interact as they flow in different directions. *How a Blast Furnace Works*, CX 86 at EPA-18466; ALJ Hearing Transcript ("ALJ Tr.") at 1074 (testimony of Dr. Fruehan), 2376 (testimony of Mr. Rorick). Iron ore and coke[11] (collectively, the "burden") are loaded into the top of the furnace. *How a Blast Furnace Works*, CX 86 at EPA-18464. Near the bottom, hot air ("the hot blast") is blown into the blast furnace through vents known as "tuyeres." *Id*. at EPA-18464, EPA-18467. Hot blast temperatures range from 1,600° Fahrenheit ("F") to 2,300° F. *Id*. at EPA-18467. The hot blast gasifies and ignites the coke in a void in the burden by the tuyeres known as the "raceway" or "combustion zone." *Id. at* EPA-18464; ALJ Tr. at 2384-85 (testimony of Mr. Rorick); 50 Fed. Reg. at 49,172. Combustion of the coke raises the temperature in the raceway to as high as 3,600°F to 4,200°F. *How a Blast Furnace Works*, CX 86 at EPA-18465, EPA-18467. The combustion also creates reducing gases, mainly carbon monoxide, which are critical to the chemical reactions necessary to the functioning of the furnace.[12] *Id*. at EPA-18465.

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[10] Carbon Injection Systems' expert witness Mr. Frederick Rorick endorsed this volume as providing a "more complete understanding" of iron blast furnaces. Frederick C. Rorick, Technical Report on Blast Furnace Issues in the Matter of Carbon Injection Systems, LLC, et al., Docket No. RCRA-05-2011-0009 (undated), *Technical Report on Blast Furnace Issues*, RX 108 at CIS02027. The editor of this volume, David H. Wakelin, is a consultant to Carbon Injection Systems. The Region's ironmaking expert witness agreed that he is knowledgeable in the ironmaking field. ALJ Tr. at 1173 (testimony of Dr. Fruehan).

[11] Coke is a "carbonaceous residue remaining from the dry (destructive) distillation of a coking coal." *McGraw Hill Concise Encyclopedia of Science & Technology* 437 (4th ed. 1998). Its principal constituent is carbon. *Id*. Coke is "formed when coal is heated in the absence of air." *Id*.; *see How a Blast Furnace Work*s, CX 86 at EPA-18465.

[12] Initially, the carbon in coke is combusted to carbon dioxide producing heat according to the following chemical formula: $C + O_2 \rightarrow CO_2 + Heat$. Because this reaction takes place in the very high temperature in the raceway and in the presence of excess carbon, the carbon dioxide is reduced or dissociates to carbon monoxide as follows: $CO_2 + C \rightarrow 2CO$. How a *Blast Furnace Works*, CX 86 at EPA-18465.

Both the remaining gases from the hot blast and the reducing gases – now heated to temperatures exceeding 3,500° F – rise through the burden toward the top of the furnace. As they ascend, they heat the burden, which softens and melts the ore, and preheats the coke prior to its combustion. The ascending gases also supply the heat necessary to drive the chemical reactions between the carbon monoxide and the iron ore, bonded iron (Fe) and oxygen (O), which strips the oxygen from the ore.[13] *Id*. The melted elemental iron resulting from these chemical reactions continues to move downward in the furnace – in the opposite direction of the hot blast and reducing gases – and collects in the hearth at the bottom of the furnace. *Id*. at EPA-18465, EPA-18467. The melted liquid iron, or "hot metal," is comprised of the elemental iron, a relatively small amount of carbon, and significantly smaller amounts of other minerals. *Id*. at EPA-18466. At the top of the furnace, the emerging gases (the "top gas") generally are captured and reused to heat the hot blast or for other heating purposes. *Id*. at EPA-18466, EPA-18467; *Ironmaking Volume* at 728; ALJ Tr. at 1074-75, 1125, 1133 (testimony of Dr. Fruehan), 2461-62 (testimony of Mr. Rorick), 2570-71 (testimony of Dr. Poveromo); Letter from Dr. David H. Wakelin, Ironmaking Consultant, to Troy Charpia, Innovative Waste, *Characteristics of the Blast Furnace Raceway*, CX 13 at EPA-10113) [hereinafter *Characteristics of the Blast Furnace Raceway*].

Due to the high cost of coke, iron makers have developed strategies for reducing its use. One successful strategy is injecting hydrocarbon materials *(*i.e., those containing carbon and hydrogen atoms), such as pulverized coal, oil (i.e., liquid hydrocarbons), and natural gas, through small pipes or lances in the tuyeres as a partial replacement for coke. 50 Fed. Reg. at 49,172; *Ironmaking Volume* at 706; ALJ Tr. at 1075-76 (testimony of Dr. Fruehan), 2389 (testimony of Mr. Rorick). These injected materials "combine with the coke to release additional

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[13] The reduction reactions that strip the oxygen from the iron ore and the temperature at which these reactions occur are:

1) $3Fe_2O_3 + CO \rightarrow CO_2 + 2Fe_3O_4$	Begins at 850° F
2) $Fe_3O_4 + CO \rightarrow CO_2 + 3FeO$	Begins at 1100° F
3) $FeO + CO \rightarrow CO_2 + Fe$ or $FeO + C \rightarrow CO + Fe$	Begins at 1300° F

How a Blast Furnace Works, CX 86 at EPA-18465.

energy which is necessary to increase productivity." *How a Blast Furnace Works*, CX 86 at EPA-18467.

C. *The Positions of the Parties*

The central issue in this case revolves around the role hydrocarbon injectants play in a blast furnace. The Region maintains that certain hydrocarbon materials injected by Carbon Injection Systems into the WCI Steel Blast furnace were "solid wastes/waste" because the materials were recycled by being "burned to recover energy." Before the ALJ, the Region argued that hydrocarbon injectants are burned for energy recovery because they provide substantial, useful heat energy both when the injectant is initially combusted upon the addition of injectants into the furnace and through the subsequent capture and reuse for heating applications of some portion of the injectants' combustion products in the furnace's top gas. Region 5's Init. Post-[ALJ] Hrg. Brf. at 46. On *sua sponte* review, the Region apparently has revised this argument, claiming that injectants only provide heat through reuse of their captured top gas. Response Brief of the U.S. Environmental Protection Agency at 1 ("Region 5's Resp. Brf."); Post-Argument Brief of Appellant U.S. Environmental Protection Agency at 14 ("Region 5's Post-Arg. Brf."). The Region also argues, as it did in the evidentiary hearing, that injectants are burned for energy recovery because their combustion in a blast furnace supplies chemical energy to the furnace in the form of reducing gases. Region 5's Init. Post-[ALJ] Hrg. Brf. at 46.

In the proceeding below, Carbon Injection Systems disputed the Region's claim that the combustion of hydrocarbon injectants add substantial, useful heat to the furnace, seizing on the fact that the use of these injectants results in a "net" temperature reduction in the blast furnace raceway. Carbon Injection Systems LLC, Scott Forster and Eric Lofquist's Initial Joint Post-[ALJ] Hrg. Brief at 20-22 (redacted version). Carbon Injection Systems renews that claim before the Board, and also argues that the issue of whether the injectants' top gas supplies heat is not properly before the Board. Respondents Carbon Injection Systems LLC, Scott Forster and Eric Lofquist's Opening Brief at 28 ("CIS' Opening Brf."); Respondents Carbon Injection Systems LLC, Scott Forster and Eric Lofquist's Motion to Strike at 3-4. Carbon Injection Systems further claims that the chemical energy that injectants provide is not within the regulatory meaning of "burned to recover energy." CIS' Opening Brf. at 9-12.

D. *The Meaning of the Phrase "Burned To Recover Energy"*

The ALJ interpreted the plain language of the regulatory phrase, "burned to recover energy," as being limited to the combustion of fuel for the recovery of heat energy. Init. Dec. at 47-48. The Initial Decision held that the term "energy" means energy in the form of heat, and heat only. The ALJ found that this interpretation was supported by the plain meaning of the regulatory language in EPA's and Ohio's RCRA regulations, and EPA's consistent interpretation of the phrase in regulatory preambles and EPA policy. *Id.* We disagree with the ALJ's plain language interpretation as the plain language can naturally be read more broadly. Nonetheless, the ALJ correctly held that EPA had interpreted the phrase "burned to recover energy" in regulatory preambles and guidance documents as applying only to the recovery of heat energy.

1. *Plain Language*

As explained in more detail below, examining the phrase, "burned to recover energy," leads to two conclusions. First, the ALJ's plain language interpretation of this phrase is inconsistent with the broad language used by Congress, EPA, and Ohio, and with RCRA's broad remedial purpose. Second, consideration of all of the terms in this phrase suggests that the ALJ's equation of the term "energy" with only "heat energy" would potentially narrow the phrase in a manner that is at odds with the expansive language of the phrase and the underlying intent of Congress and EPA.

Both the terms "burn" and "energy" are quite broad. As the ALJ noted, the term "burn" can mean "to consume as fuel" or "to transform by the controlled action of fire or heat." *Webster's Third International Dictionary* 299 (2002) [hereinafter *Webster's Third*] (citing the first and third definitions of the verb transitive form of "burn"); *see* Init. Dec. at 41. The first of these definitions focuses on the *consumption* of fuel (e.g., the engine burned the fuel), whereas the second focuses on the *effect* on the material being burned (e.g., the wood was burned to create charcoal). The term is even so broad that it covers producing a "comparable effect" to that caused by fire or heat by another agent such as "by certain radiations, chemicals, or friction." *Id.* For example, over-exposure to the sun can lead to "burning" of skin and over-use of chemical fertilizers can produce "burning" of plants.

The term energy, in the context in which it is used in EPA's and Ohio's waste regulations, is defined as "an entity rated as the most fundamental of all physical concepts and usually regarded as the equivalent of or the capacity for doing

work."[14] *Webster's Third*, at 751 (citing the fifth definition). Given the scientific nature of the *1985 Burning of Waste Fuel Rule*, reference to a science dictionary is helpful. The *McGraw Hill Concise Encyclopedia of Science & Technology* defines "energy" as:

> The ability of one system to do work on another system. There are many kinds of energy: chemical energy from fossil fuels, electrical energy distributed by a utility company, radiant energy from the Sun, and nuclear energy from a reactor.

McGraw Hill Concise Encyclopedia of Science & Technology 735 (4th ed. 1998) (hereinafter "*McGraw Hill Concise Encyclopedia*"); *accord Hawley's Dictionary* at 501. Notably, both the standard and science definitions cited above do not define energy in terms of heat.[15] In fact, the *McGraw Hill Concise Encyclopedia* stresses that "[w]ork and heat have the same units as energy, but are entirely different physical concepts," and defines "heat" as a particular form of energy. *McGraw Hill Concise Encyclopedia*, at 735, 933; *accord Van Nostrand's Encyclopedia of Chemistry* 562 (5th ed. 2005) ("heat can be considered a form of energy") [hereinafter *Van Nostrand's*]. It states that "heat" is "that form of energy in transit due to a temperature difference between the source from which the energy is coming and the sink toward which the energy is going. The energy is not called heat before it starts to flow or after it has ceased to flow." *Id*. at 933. At most, heat is regarded as only one of many forms of energy. Thus, the broad meanings of the terms "burn" and "energy" show that the plain meaning of the phrase "burned to recover energy" is not limited to the recovery of heat energy.

The word "recover" in the phrase "burned to recover energy" reinforces our conclusion that the ALJ misinterpreted the phrase's plain meaning. The word "recover" means "to get back what has let go or lost." *Webster's Third*, at 1898. But "burning" of a material does not "recover" or "get back" heat from the material; rather, it "recovers" the chemical energy in the material in the form of heat. *See*

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[14] "Energy" has several other meanings unrelated to hazardous waste regulation. *See Webster's Third*, at 751 (defining energy as including "imaginative or affective force" and "the capacity of acting, operating, or producing an effect").

[15] The ALJ relied on a dictionary definition of energy as "usable power (as heat or electricity)." Init. Dec. at 42 (quoting Merriam-Webster's Collegiate Dictionary 383 (10th ed. 1997). Even this definition, however, only lists "heat" as one of two examples of energy. Further, this dictionary also defines "energy" as "the capacity to do work." *Id*.

Van Nostrand's Encyclopedia, at 423 ("In combustion, chemical energy is exchanged for energy in the form of heat."). An example of heat being "recovered" is a geothermal heat system that "recovers heat energy" by taking advantage of the temperature differential between "a mass of subsurface rock and water and a mass of water or air at the Earth's surface." *McGraw Hill Concise Encyclopedia*, at 883. Thus, interpreting the phrase "burned to recover energy" as only applying to the *recovery* of heat energy could narrow the meaning of the phrase in a manner neither consistent with plain language nor the primary activity Congress and EPA intended to regulate – i.e., burning hazardous wastes and contaminated used oils to produce heat. *See* H. Rep. No. 98-198, at 39 (1983), *reprinted in* 1984 U.S.S.C.A.N. 5576, 5598; S. Rep. No. 284, 98th Cong., at 36 (1983); 50 Fed. Reg. at 49,165-67.

The ALJ based her interpretation on the testimony of the Region's expert witness that heat energy is what is "commonly" thought of upon mention of the term "energy." Similarly, Carbon Injection Systems argues that the chemical energy in the reducing gases produced by the combustion of the hydrocarbon injectants does not fit within "the ordinary, everyday, common meaning of the word 'energy.'" CIS' Opening Brief at 11. But the mere fact that heat energy is the form of energy "that most immediately comes to mind" does not "exclude[]" any other forms of energy from that term. *See Smith v. U.S.*, 508 U.S. 223, 228-29 (1993) (interpreting the phrase "uses * * * a firearm" to include not only using a firearm as a weapon, but also using a firearm as an item of barter or commerce). For example, cow's milk may be what one commonly thinks of when one hears the word, "milk," but that does not mean that goat's or sheep's milk is not "milk." In any event, chemical energy fits well within the definition of "energy" in both standard and technical dictionaries. Given the consistency between standard and technical dictionaries, we see no reason to look elsewhere for plain meaning.

Additionally, the ALJ erred by relying on an industry expert's testimony concerning the common, ordinary meaning of a term. Expert testimony may be useful to explicate an industry "term of art" or complex scientific terms used in a contract or patent. *See Phillips v. AWH Corp*., 415 F.3d 1303, 1318 (Fed. Cir. 2005), (stating that "expert testimony can be useful to a court for a variety of purposes, * * * [including] to establish that a particular term in the patent or the prior art has a particular meaning in the pertinent field"); *Kona Tech. Corp. v. S. Pac. Transp. Co*., 225 F.3d 595, 611 (5th Cir. 2000) (allowing expert testimony to interpret contract terms having a specialized meaning in the railroad industry). But "'[a]bsent any need to clarify or define terms of art, science or trade, expert opinion testimony to interpret contract language is inadmissible.'" *North Am. Specialty Ins. Co. v. Myers*, 111 F.3d 1273, 1281 (6th Cir. 1997) (quoting *TCP Indust., Inc. v. Uniroyal, Inc.*, 661 F.2d 542, 549 (6th Cir. 1981)"); *see Coregis Ins. Co. v. Bell*,

1999 U.S. Dist. LEXIS 6002 (E.D. La. Apr. 21, 1999) (holding that an "English Language Expert" was not permitted to testify to the meaning of words in a contract because the words were not "terms of art science, or trade"). No more lenient approach should be employed for expert testimony on statutory or regulatory terms given the general presumption against expert testimony on legal questions in judicial proceedings. *See Nieves-Villanueva v. Soto-Rivera*, 133 F.3d 92, 99 (1st Cir. 1997) (citing cases barring expert testimony on legal questions); *see also Ways v. City of Lincoln*, 206 F. Supp. 2d 978, 991 (D. Neb. 2002) *aff'd*, 331 F.3d 596 (8th Cir. 2003) (holding that "expert testimony that purports to *explain the legal meaning of a term* is forbidden * * *, but testimony *defining a term of art* [in an ordinance] as it is used within a given field may be allowed"). Arguably, the word "energy" is a scientific term, but the ALJ relied on an iron and steel industry expert not for the scientific meaning of the word, but rather for a layperson's understanding of its meaning.

The ALJ was on firmer ground in looking to a dictionary to gauge the meaning of the term "energy." Courts have traditionally relied on dictionaries as generally providing an objective extrinsic guide to the ordinary, non-technical meaning of a word. *See, e.g., Phillips*, 415 F.3d at 1318 (finding that "[b]ecause dictionaries, and especially technical dictionaries, endeavor to collect the accepted meanings of terms used in various fields of science and technology, those resources have been properly recognized as among the many tools that can assist the court in determining the meaning of particular terminology to those of skill in the art of the invention"); *United States v. Lachman*, 387 F.3d 42, 51 (1st Cir. 2004) (noting that "[d]ictionaries of the English language are a fundamental tool in ascertaining the plain meaning of terms used in statutes and regulations"); *Tex. Digital Sys. v. Telegenix, Inc.*, 308 F.3d 1193, 1203 (Fed. Cir. 2002) (stating that dictionaries, encyclopedias, and treatises "are often used to aid in the interpretation of statutes and regulations and in the interpretation of terms used in contracts"). And the Board frequently relies on dictionaries in interpreting regulatory language. *See, e.g.*, *In re Andrew B. Chase*, 16 E.A.D. 469, 479-80 (EAB 2014).

Given that burning includes both combusting and transforming objects by fire and other agents and that "energy" comes in many forms – *e.g.*, chemical, electrical, solar, nuclear, and heat – we find that the ALJ erred in holding that the plain meaning of the phrase "burned to recover energy" in Ohio's and EPA's RCRA regulations is necessarily limited to the recovery of only heat energy. The Board further holds that nothing in the plain language of the phrase precludes the Region from interpreting "burned to recover energy" as including transforming the chemical energy in fossil fuel by combustion to a more useful form of chemical energy.

2. *EPA's Interpretation*

That the plain meaning of the regulatory phrase, "burned to recover energy," *can* support the recovery of chemical energy does not end our inquiry. We next examine how EPA has interpreted this regulatory phrase and whether Carbon Injection Systems had notice of EPA's interpretation at the time of the alleged violative actions. The ALJ concluded that her plain language interpretation of the phrase "burned to recover energy" was supported by longstanding EPA interpretations advanced in rulemaking preambles and EPA policy statements, and in EPA exchanges with Carbon Injection Systems before this enforcement action began. Init. Dec. at 43-47. For the reasons discussed below, we agree that notwithstanding the broader plain language meaning of this regulatory phrase, EPA's contemporaneous and longstanding interpretation of the phrase "burned to recover energy" limited that phrase to the combustion of materials for their *heat* value.

In the preamble to the *1985 Burning of Waste Fuel Rule*, the EPA Administrator clearly interpreted the phrase "burned to recover energy" as meaning to combust waste to recover its heat value. 50 Fed. Reg. at 49,167, 49,171-74. This interpretation is dispositive for the purposes of this case because not only did EPA provide a general interpretation of the phrase "burned to recover energy," but it interpreted and applied the phrase to hydrocarbon injectants added to an iron blast furnace in circumstances indistinguishable from this case.

EPA first addressed the meaning of the phrase "burned to recover energy" in responding to comments questioning whether the *1985 Burning of Waste Fuel Rule* "would apply when energy recovery from burning hazardous wastes is merely incidental, or when energy recovery is not the principal purpose of burning." 50 Fed. Reg. at 49,167. While explaining that the rule covered circumstances where energy recovery was not the principal purpose for the burning of hazardous waste, EPA also clarified that "energy recovery" meant supplying "heat energy." Specifically, EPA stated that the rule would apply "if hazardous wastes * * * are burned in industrial furnaces or boilers both to recover energy (i.e., *to provide substantial, useful heat energy*) and for some other recycling purpose, even if

energy recovery is not the predominant purpose of the burning."[16] *Id*. (emphasis added). Notably, EPA chose to use the abbreviation "i.e." rather than "e.g." The Latin phrase *id est* (i.e.) translates to English as "that is," *Webster's Third*, at 1124, and *exempli gratia* (e.g.) translates as "for example." *Id*. at 726. Thus, EPA equated providing heat with energy recovery, and did not use heat merely as an example of energy recovery. EPA concluded its response to this inquiry with a strong reiteration of this interpretation of energy recovery as burning to provide heat:

> Consequently, these rules apply where hazardous wastes are burned in boilers or industrial furnaces *and provide substantial, useful heat energy*. Such burning is considered to involve a hazardous waste fuel within the meaning of RCRA section 3004(q).

50 Fed. Reg. at 49,167 (emphasis added).

Later in the preamble to the same rule, EPA removed any doubt as to whether the phrase "burned to recover energy" might extend to burning to recover other forms of energy, such as chemical energy. Several commenters on the rule had argued that burning of a certain hazardous waste injectant, "Cadence product 312," in iron blast furnaces was not for energy recovery because the injectant merely "provide[s] ingredients necessary to drive furnace reactions" and any heat produced from its burning is "incidental" to the blast furnace. *Id*. at 49,171. EPA disagreed, finding that the Cadence product "in fact releases substantial, useful heat energy to a blast furnace and, thus, is burned *partially* for energy recovery within all reasonable understanding of that term." *Id*. at 49,172 (emphasis added).

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[16] Earlier EPA pronouncements in the Federal Register are consistent with this interpretation in that they treat burning waste for its heat value as synonymous with burning for energy recovery. Standards for the Management of Specific Types of Facilities, 50 Fed. Reg. 1684, 1690 (Jan. 11, 1985) (stating that "burning" is not for "legitimate energy recovery" in situations "when no usable heat is recovered from the combustion unit"); Enforcement Guidance, 48 Fed. Reg. 11,157, 11,158 (Mar. 16, 1983) (noting that "burning" must "recover sufficient energy to characterize the practice as legitimate recycling" * * * and "EPA ordinarily views the practice of direct burning of hazardous wastes with little or no heat value as 'fuels' as not being legitimate recycling"); Identification and Listing of Hazardous Waste, 45 Fed. Reg. 33084, 33093 (May 19, 1980) (stating that "bona fide" recycling does not include "burning organic wastes that have little or no heat value in industrial boilers under the guise of energy recovery").

The key word in this sentence is "partially." EPA recognized that the burning of hydrocarbon injectants (as well as coke) had two key purposes in a blast furnace: (1) supplying the reducing gas carbon monoxide, which provides the *chemical* energy necessary to drive the chemical reactions that remove oxygen from the iron ore; and (2) providing substantial, useful *heat* energy to the furnace. *Id*. Yet, repeatedly, EPA emphasized that injectants are burned only in part for energy recovery, and the part of the burning EPA cited as qualifying as energy recovery was burning for heat. *Id*. at 49,171-72, 49,174. Thus, when directly faced with a nearly identical example as the case before the Board of burning hydrocarbon waste for the recovery of both heat and chemical energy, the EPA Administrator chose at that time not to interpret the phrase "burned to recover energy" to include recovery of chemical energy.

The Region disputes this reading of the Cadence product discussion in the preamble to the *1985 Burning of Waste Fuel Rule*, pointing to other language in the preamble in which EPA acknowledged that the carbon monoxide produced by coke and injectants drives energy-absorbing reactions that reduce the iron ore. Region 5's Post-Arg. Brf. at 4-5 (citing 50 Fed. Reg. at 49,172). But this language in the preamble hurts rather than helps the Region's argument. The language shows that EPA recognized that burning injectants releases chemical energy in the form of reducing gases. Nonetheless, EPA repeatedly based its conclusion that injectants are "burned to recover energy" not on the chemical energy released in the form of the reducing gas carbon monoxide, but only on the heat energy their combustion provides. Moreover, EPA cited steam – a blast furnace injectant that provides only chemical energy (i.e., just reducing gases) and not heat – as an example of an injectant not captured by the "burned to recover energy" standard. 50 Fed. Reg. at 49,173. Specifically, EPA stated "[i]njectants that have no heating value like steam, * * * are not considered to be fuel injectants. Thus, injectants with no or minimal heating value * * * are not considered to be burned for energy recovery." *Id*. Accordingly, we conclude that the Administrator declined in the *1985 Burning of Waste Fuel Rule* to adopt the chemical energy interpretation the Region now advocates.

The Region also claims that a general description of blast furnaces in a preamble to a 1987 proposed rule to establish controls on the burning of hazardous wastes in boilers and industrial furnaces implies that the phrase "burned to recover energy" covers injectants burned for the recovery of chemical energy in the form of reducing gases. Opening Brief of the U.S. Environmental Protection Agency at 21 ("Region 5's Opening Brf."); *see* Burning of Hazardous Waste in Boilers and Industrial Furnaces, 52 Fed. Reg. 16,982, 16,987 (May 6, 1987). But this preamble does not explicitly mention "chemical energy," as the Region admits, and never

even links injectants to the production of reducing gases. *See* 52 Fed. Reg. at 16,987. Finally, the Region cites to preamble language for this same 1987 rule that notes that "hazardous wastes" burned in boilers and industrial furnaces are to be covered by proposed new substantive controls "irrespective of the heating value of the hazardous waste." *See* Region 5's Opening Brf. at 23 (quoting 52 Fed. Reg. at 16,989); *see* Burning of Hazardous Waste in Boilers and Industrial Furnaces, 56 Fed. Reg. 7,134, 7,138 (Feb. 21, 1991). But this language does not amend what qualifies as recycling materials by burning for energy recovery. Rather, this language points out that the proposed rule covers both hazardous wastes incinerated in boilers and industrial furnaces and hazardous wastes burned for energy recovery in boilers and furnaces. 52 Fed. Reg. at 16,989. Thus, because this rule applies to both of these types of hazardous/solid wastes (i.e., materials that are abandoned by incineration and materials recycled by burning for energy recovery), the rule does apply "irrespective of the heating value of the hazardous waste." *Id*.; *see* 56 Fed. Reg. at 7,138. This factually true statement does not imply that the phrase "burned to recover energy" covers types of energy other than heat energy.

Reading the *1985 Burning of Waste Fuel Rule* as adopting an interpretation of the phrase "burned to recover energy" as applying only to heat energy is confirmed by the manner in which EPA defined this phrase in the 1998, 2003, 2006, 2008, 2011, and 2014 editions of EPA's *RCRA Orientation Manual*.[17] The Manual states that it is intended to "serve[] as an effective introduction to the various facets and basic structure of the RCRA program" and "is designed for EPA and state staff, members of the regulated community, and the general public who wish to better understand RCRA." *See, e.g.*, U.S. EPA, EPA530-R-02-016, *RCRA Orientation Manual* v (Jan. 2003). In the foreword to the RCRA Manual, EPA expressly describes the Manual as a "popular and valuable resource for anyone working with EPA's solid and hazardous waste management program." *Id*. at vii. Its frequent updating and republication stand as a testament to that fact. In six editions of this

[17] U.S. EPA, EPA530-F-11-003, *RCRA Orientation Manual 2014* (Oct. 2014); U.S. EPA, EPA530-F-11-003, *RCRA Orientation Manual 2011* (Oct. 2011); U.S. EPA, EPA530-R-07-010, *RCRA Orientation Manual 2008* (Dec. 2007); U.S. EPA, EPA530-R-06-003, *RCRA Orientation Manual 2006* (Mar. 2006); U.S. EPA, EPA530-R-02-016, *RCRA Orientation Manual* (Jan. 2003); U.S. EPA, EPA530-R-98-004, *RCRA Orientation Manual* (May 1998). These Manuals are available on EPA's website at: http://cfpub.epa.gov/ols/catalog/catalog_records_found.cfm?&FIELD1=KEYWORD&INPUT1=RCRA Orientation Manual&TYPE1=NONE

Manual issued between 1998 and 2014, EPA defines "burning for energy recovery" as "[b]urning hazardous waste for its heating value as a fuel, and using wastes to produce fuels or as ingredients in fuels." *See, e.g.*, U.S. EPA, EPA530-F-11-003, *RCRA Orientation Manual 2014* C-2 (Oct. 2014); U.S. EPA, EPA530-R-98-004, *RCRA Orientation Manual* D-2 (May 1998). Nowhere in the Manual does EPA include burning to recover *chemical* energy within the meaning of this phrase.

Accordingly, the Board concludes that EPA's longstanding interpretation of the phrase "burned to recover energy" narrowly construed the otherwise broad language of the regulation. Although the plain language of the regulation can encompass recovering chemical energy through combustion, EPA interpreted the meaning of the phrase as limited to the recovery of a material's heat energy. Certainly, EPA may change its current interpretation of this critical jurisdictional phrase as to prospective determinations of the scope of the RCRA regulatory program should it so choose. However, in this case, the Region has argued that Carbon Injection Systems is subject to RCRA permitting requirements under both EPA's prior construction of "burned to recover energy" and the Region's expanded interpretation of that phrase adopted in this litigation. We next address whether such an enforcement approach is consistent with the doctrine of fair notice.

3. *Fair Notice*

Due process requires that administrative agencies provide fair notice to the regulated community of its obligations under agency regulations. *Gen. Elec. Co. v. EPA*, 53 F.3d 1324, 1328-29 (D.C. Cir. 1995); *Howmet Corp.*, 13 E.A.D. at 303. Absent such fair notice, an agency may not hold a party liable for a regulatory violation. *See Gen. Elec.*, 53 F.3d at 1334 (noting that a lack of fair notice barred EPA from holding General Electric "responsible in any way – either financially or in future enforcement proceedings – for the actions charged in this case"). In resolving fair notice claims, our cases apply an "ascertainable certainty" test: "the question is not whether a regulation is susceptible to only one possible interpretation, but rather, whether the particular interpretation advanced by the regulator was ascertainable by the regulated community." *In re Tenn. Valley Auth.*, 9 E.A.D. 357, 412 (EAB 2000).

In applying the ascertainable certainty test, the Board begins with the text of the regulation. *Howmet*, 13 E.A.D. at 305 (noting that "we begin, of course with the text of the applicable regulation itself"); *Gen. Elec.*, 53 F.3d at 1329 (stating that a court "must ask whether the regulated party received, or should have received, notice of the agency's interpretation in the most obvious way of all: by the reading of the regulations"). Other factors, however, may carry considerable

weight. The Board has found that fair notice can be provided by the context of the regulation's promulgation, including the underlying statutory and regulatory structure, the legislative intent of Congress, and judicial construction of similar provisions. See *Tenn. Valley Auth*., 9 E.A.D. at 412; *Howmet*, 13 E.A.D. *at* 306 (examining the regulations "as a whole" as part of the fair notice inquiry).

Agency interpretations of the regulation – both publicly-released interpretations and interpretations provided directly to the party in question – also can have a decisive impact on the fair notice question. An agency's interpretation of a regulation can resolve ambiguities in regulatory language and make the meaning of the regulation ascertainably certain to regulated parties. *See Howmet*, 13 E.A.D. at 307 (finding that Agency statements provided "ample information * * * by which Howmet could have determined the Agency's orientation and interpretation with ascertainable certainty"); *but see In re Coast Wood Preserving*, 11 E.A.D. 59, 86-87 (EAB 2007) (concluding that preamble statements and other guidance documents did not clarify an ambiguous regulation). On the other hand, conflicting statements by agency officials evidencing a "difference of opinion" may detract from the fair notice the regulation and agency interpretations otherwise provide. *Gen. Elec*., 53 F.3d at 1332 (noting that "confusion at the [EPA] regional level is yet more evidence that the agency's interpretation of its own regulation could not possibly have provided fair notice."). Similar fair notice problems arise when agency statements prior to an enforcement action conflict with the interpretation underlying that action. *See Trinity Broad. of Fla., Inc. v. FCC*, 211 F.3d 618, 629 (D.C. Cir. 2000) (holding that an agency did not provide fair notice of its interpretation of a regulation when, despite the fact that a reasonable reader might have been able to ascertain that interpretation from the regulation's text, the agency's "only clear statements" on a key term in the regulation prior to taking punitive action were contrary to this reasonable reader interpretation). Finally, in situations where there is ambiguity given the regulation's meaning, the Board and federal courts have taken into account whether the alleged violator made any effort to consult the agency before acting. *In re Morton L. Friedman & Schmitt Constr. Co*., 11 E.A.D. 302, 324 (EAB 2004), *aff'd*, *Friedman v. EPA*, No. 2:04-CV-00517-WBS-DAD (E.D. Cal. Feb. 25, 2005) (noting that where a regulation is ambiguous, a regulated party "assumes a calculated risk by failing to inquire about the meaning of the regulation").

After reviewing these considerations, we conclude that at the time of the alleged regulatory violations Carbon Injection Systems could not have ascertained the Region's new interpretation of the phrase "burned to recover energy" as including burning to recover chemical energy. The regulatory language itself is quite broad. And as our analysis of the plain language of the regulation shows, the

Region's interpretation may be a permissible interpretation of that broad language. Whatever fair notice of the "chemical energy" interpretation is provided by the regulation's text, however, must be read in the context of EPA's more limited interpretation of the text in the preamble to the *1985 Burning of Waste Fuel Rule* and EPA's *RCRA Orientation Manual*. In *Trinity Broadcasting*, the D.C. Circuit specifically held that an agency could not rely on regulatory language alone as providing fair notice of a "reasonable reader's" interpretation of the regulation in the face of prior agency notices evincing a contrary interpretation. 211 F.3d at 629. That is precisely the situation here. The phrase "burned to recover energy" may very well provide fair notice to a reasonable reader that the phrase extends to burning of materials to recover chemical energy. But EPA's explicit and narrow interpretation of that regulatory phrase in the *1985 Burning of Waste Fuel Rule* and the *RCRA Orientation Manual* clearly sets forth a reading of the regulation that excludes this broader interpretation. In these circumstances, Carbon Injection Systems could not have ascertained the Region's new "chemical energy" interpretation, and thus Carbon Injection Systems did not receive fair notice.

Moreover, before the startup of Carbon Injection Systems' Warren, Ohio facility, associates of Carbon Injection Systems sought clarification from the Region concerning whether hydrocarbon injectants, if used as a coke replacement, meet the definition of a solid waste as a recycled material burned for energy recovery in a blast furnace.[18] Init. Dec. at 18-19. One of the Carbon Injection Systems' associates, Mr. Ernie Willis, argued in an email to the Region that the recycling of hydrocarbon injectants through combustion in a blast furnace should not be considered burned for energy recovery because an injectant "isn't used for its heating value." Email from Ernie Willis, Innovative Waste Management, Inc., to John Gaitskill, U.S. EPA (Nov. 11, 2005), CX 13 at EPA-10179. He admitted that hydrocarbon injectants are burned: "We can't dispute that this material is consumed, but the simple fact is that any carbon-laden material is going to combust in a 3500 degree environment." *Id*. Nonetheless, Mr. Willis claimed that "the sole

[18] The correspondence with various regulatory agencies concerning whether hydrocarbon injectants come under RCRA jurisdiction was directly handled by S. Troy Charpia and Ernie Willis. These individuals worked at a corporation that supplied hydrocarbon materials to Carbon Injection Systems. Init. Dec. at 18. The ALJ found that: "Beginning in February of 2005 and continuing through that year, Mr. Charpia and Mr. Willis, with the assistance of Respondent Forster and Respondent Lofquist, sought the concurrence of the Louisiana Department of Environmental Quality, the Ohio EPA, and Region 5 of EPA that the use of materials designated as K022 waste in a blast furnace would not run afoul of RCRA." *Id*. at 18-19 (footnote omitted).

purpose of carbon-injection is for the production of a catalyst (carbon monoxide)." *Id*. He explained that the catalyst "carbon monoxide is the driving force behind a blast furnace. The carbon monoxide passes through the layers of coke and permeate the iron ore pellets and strips them of oxygen, thus yielding elemental iron." *Id*. He concluded that the hydrocarbon material is "being used for its properties as a catalyst, not for its heat value." *Id*. at EPA-10179.

Responding for the Region, Margaret M. Guerriero, Director of Region 5's Waste, Pesticides and Toxics Division, rejected these arguments and concluded that the "transport and treatment" of such hydrocarbon injectants "must comply with the appropriate Ohio hazardous waste regulations." Letter from Margaret M. Guerriero, Director, Waste, Pesticides and Toxics Div., Region 5, EPA, to Mr. Ernie Willis, Innovative Waste Management, Inc. (Dec. 9, 2005), CX 47 at EPA-17146. The Region explained that it interpreted the phrase "burned to recover energy" as being synonymous with use of a "fuel," and "[t]he common use of the term 'fuel' is any material used to produce heat or power by burning." *Id*. Hydrocarbon injectants produce heat in a blast furnace, the Region reasoned, because "[c]ombustion of the coke provides heat needed to melt the iron-bearing material in the furnace, and any substitute for coke is an alternate heat source or fuel." *Id*. Thus, the Region's response to the Carbon Injection Systems associate clarified that the critical inquiry under the "burned to recover energy" regulatory language is whether burning of a material recovers heat energy. Despite being confronted with the admission that the combustion of hydrocarbon injectants produces the chemical energy that is "the driving force in a blast furnace," the Region concluded that the burning of hydrocarbon injectants "recover[s] energy"

based solely on its judgment that combusting injectants recovers heat, not chemical, energy.[19]

In an attempt to preserve its claim that recycled hydrocarbon injectants are "wastes" because they are burned to recover chemical energy, the Region argues that the fair notice doctrine applies differently depending on the type of legal question involved. According to the Region, if the question concerns whether an entity or material is "subject to the regulation" – i.e., whether the entity or material comes within the regulatory program's jurisdiction – then the fair notice doctrine only requires that the entity be provided with the agency's "regulatory conclusion" that jurisdiction attaches. The Region claims that the entity is not entitled to any notice concerning the basis or "rationale" for the agency's "regulatory conclusion." Region 5's Post-Arg. Brf. at 7-8. However, if the question involves the compliance requirements under the regulation, then the Region acknowledges that the fair notice doctrine requires the Region to provide the meaning of these requirements to the entity with ascertainable certainty. *Id*. In essence, the Region is arguing that fair notice on regulatory program jurisdictional questions can be supplied by *ipse dixit* – e.g., "a permit is required for your facility" – and that only the substantive obligations imposed by the regulatory program must be "ascertainable" to the regulated party.

Relying on this theory of fair notice, the Region claims that Carbon Injection Systems received fair notice of the Region's revised interpretation of the phrase "burned to recover energy" as including the recovery of chemical energy because the Region notified Carbon Injection Systems, at least indirectly, of the

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[19] In some ways, this case is similar to our recent decision in *In re Elementis*, 16 E.A.D. 649 (EAB 2015). There, EPA sought penalties for an alleged failure of a company to submit data under the reporting requirements of the Toxic Substances Control Act. As in the present case, the Board concluded that EPA had narrowly interpreted the governing legal standard. The cases differ, however, in the enforcement theories pursued by EPA. In *Elementis*, EPA's liability theory was that the regulated party was in violation of the statutory requirement, as that requirement had been interpreted in EPA's enforcement policies. In the present case, the Region has attempted to impose liability based on a regulatory interpretation that the Board has concluded was not previously adopted by EPA. Thus, the present case squarely presents the fair notice doctrine, whereas *Elementis* did not. Nonetheless, the principle of the doctrine underlies the Board's *Elementis* decision as the Board found that EPA's ability to enforce the broad contours of the statute was constrained, at that time, by the interpretation EPA had provided in the applicable TSCA reporting policy.

Region's regulatory conclusion that use of recycled hydrocarbon injectants in a blast furnace is subject to Ohio's hazardous waste regulations. The Region argues that the "fair notice" provided by this regulatory conclusion is not diminished by the fact that this actual notice expressly relied solely on EPA's pre-litigation interpretation of the phrase "burned to recover energy" as meaning burning to recover heat energy. The Region asserts that because the fair notice doctrine does not require an agency to provide any rationale or explanation for a regulatory conclusion on whether an entity or material is subject to regulation, any additional information provided with a regulatory conclusion is irrelevant to the fair notice determination. *Id*. at 8. That is true, according to the Region, "even if the additional information provided is later determined to be outdated or wrong." *Id*. at 9.

The Region's interpretation of the fair notice doctrine fails on several grounds. First, fair notice cases emphasize that the doctrine is based on a general notion of "elementary fairness," *Radio Athens, Inc. v. FCC*, 401 F.2d 398, 404 (D.C. Cir. 1968), and is "essential to the protections provided by the Due Process Clause of the Fifth Amendment," *FCC v. Fox Television Stations, Inc*., 132 S. Ct. 2307, 2317 (2012). But the Region's fair notice argument relies solely on the technical difference between a determination of scope of regulatory jurisdiction and the meaning of regulatory requirements. The Region has advanced no rationale as to why due process requires fair notice of the substance of obligations but does not mandate such clarity concerning to whom those obligations apply. Yet, either situation would appear to trigger the same "elementary fairness" considerations underlying the fair notice doctrine.

Second, the precedent cited by the Region is unpersuasive. The Region primarily relies on general statements of the fair notice doctrine from two leading fair notice cases, *Fox Television* and *General Electric*. It claims that these general statements indicate that the fair notice doctrine is focused only on "the requirements with which the party must comply." Region 5's Post-Arg. Brf. at 8. The *Fox Television* and *General Electric* cases, however, involved fair notice challenges to substantive obligations and not a fair notice question regarding the jurisdictional scope of a regulatory program. *Fox Television*, 132 S. Ct. at 2320 (holding that the FCC had not provided fair notice on whether fleeting expletives or momentary nudity was barred by the statutory proscription on "indecent" action); *Gen. Elec*., 53 F.3d at 1330 (holding that regulations requiring disposal of polychlorinated biphenyls did not provide fair notice that the regulations prohibited pre-disposal processes like distillation). Thus, it is unremarkable that these cases focus on the fair notice doctrine's implications as to substantive compliance obligations. In any event, the Region's close parsing of the cases' general pronouncements is unconvincing. To a large extent, the general language in these cases is consistent

with applying the fair notice doctrine to the jurisdictional issue in this case. For example, *Fox Television* emphasizes that fair notice must be provided of the "conduct that is forbidden or *required*." *Fox Television*, 132 S. Ct. at 2317 (emphasis added). The very question in this case is whether Carbon Injection Systems' use of hydrocarbon injectants *required* it to obtain a RCRA permit.

The Region also cites to a hypothetical in the *General Electric* decision as precedent for its fair notice theory that nothing more than notice of the agency's "regulatory conclusion" is required on jurisdictional issues. But the Region distorts the meaning of the hypothetical by quoting only a portion of it, and largely removing the hypothetical from its context. The hypothetical addressed the issue of whether an agency could provide fair notice of an agency interpretation through a pre-enforcement warning to the party in question. The *General Electric* court noted that "fair notice of an [agency's] regulatory *interpretations*" can be provided to the public by the regulation itself as well as by the "agency's pre-enforcement efforts to bring about compliance." 53 F.3d at 1329 (emphasis added). The court then used the following two sentences to present two contrasting enforcement scenarios to illustrate when fair notice is and is not provided by pre-enforcement agency efforts (the Region quotes the first part of the first sentence but we provide both sentences in full, italicizing what the Region omitted):

> If, for example, an agency informs a regulated party that it must seek a permit for a particular process, but the party begins processing without seeking a permit, the agency's pre-violation contact with the regulated party has provided notice, *and we will enforce a finding of liability as long as the agency's interpretation was permissible. In some cases, however, the agency will provide no pre-enforcement warning, effectively deciding "to use a citation [or other punishment] as the initial means for announcing a particular interpretation" – or for making its interpretation clear.*

Id. (emphasis added). After presenting the hypothetical, the D.C. Circuit immediately returned to the facts of the case before it noting that General Electric claimed it had received no pre-enforcement warning. Thus, the court saw its task as determining whether General Electric received "notice of the agency's *interpretation*" from "the regulations and other public statements issued by the agency." *Id*. (emphasis added). The clear intent of the D.C. Circuit's hypothetical was to juxtapose a situation in which an agency provides notice of a regulatory *interpretation* through a pre-enforcement warning and a situation where the agency provides no warning, and uses the enforcement action to announce the

interpretation. Reading anything more into this hypothetical is not supported by the circumstances of the case.[20]

Finally, the Region's fair notice argument fails because it proves too little. The Region's argument addresses only the fair notice problem raised by the disconnect between the Region's litigation position and the legal interpretation in the Region's letter to the Carbon Injection Systems associate. Nowhere does the Region suggest that a bald "regulatory conclusion" can supply fair notice of a new, unstated agency interpretation in the face of authoritative and repeated published statements by an agency of a contrary interpretation – particularly, where, as here, the "regulatory conclusion" is accompanied by a repetition of the longstanding, contrary interpretation.

Accordingly, the fair notice doctrine bars the Region from penalizing Carbon Injection Systems for its actions between 2005 and 2008 based on an interpretation of the phrase "burned to recover energy" as including the recovery of chemical energy in blast furnaces. At the same time, EPA unquestionably provided fair notice that it considered hydrocarbon wastes burned in iron blast furnaces for, among other purposes, their heat value to be "burned to recover energy" and thus qualify as "wastes" under the relevant provisions of the Ohio Administrative Code. We turn now to whether EPA proved that element of its enforcement case.

E. *The Region Met Its Burden of Proving That Carbon Injection Systems Burned Hydrocarbon Injectants in the WCI Steel Blast Furnace for Recovery of Their Heat Value*

To recap, in the preamble to the *1985 Burning of Waste Fuel Rule*, the EPA Administrator interpreted the phrase "burned to recover energy" as meaning the combustion of material for the purpose of producing "substantial, useful heat."

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[20] We do not read this hypothetical as necessarily requiring that the pre-enforcement warning expressly state the agency's interpretation. In some situations, an agency's pronouncement that a permit is required may, given the individual circumstances, implicitly convey the agency's interpretation of the governing regulatory provision. That, however, was not the case here. We also note that the D.C. Circuit's hypothetical appears to recognize that advancing a revised interpretation in an enforcement proceeding does not invariably deny fair notice to the party being held to account, though it does potentially raise a fair notice question. *Gen. Elec.*, 53 F.3d at 1329 (citing *Martin v. OSHRC*, 499 U.S. 144, 158 (1991), for the proposition that such a practice "may raise a question about 'the adequacy of notice to regulated parties'").

50 Fed. Reg. at 49,167. Moreover, EPA made clear that burning a waste for its heat value did not have to be the sole, or even the primary, purpose for its combustion for the waste to qualify as a "solid waste." *Id*. Finally, EPA unequivocally determined, in discussing the Cadence product, that the combustion of hydrocarbon waste with substantial heating value in an iron blast furnace provides substantial, useful heat energy to the furnace and thus qualifies as recycling by burning for energy recovery. *Id*. at 49,172. This substantial, useful heat, according to EPA, is supplied both by combusting the injectants in the furnace's raceway, and subsequently capturing carbon monoxide products from this combustion in the furnace's top gas and using this top gas to heat the hot blast. *Id*. at 49,172-73.

In this case, the Region asserts that various liquid hydrocarbon materials acquired and used by Carbon Injection Systems were "wastes/solid wastes" because those materials were recycled in an iron blast furnace by burning for energy recovery. The Region bears the burden of presentation and of persuasion on that issue. (*See* Section IV, *supra*). To meet that burden, the Region relies primarily on EPA's prior determination on the Cadence product that hydrocarbon wastes combusted in an iron blast furnace are burned for their heat value and an expert witness who largely confirmed EPA's prior conclusion.

Carbon Injection Systems contends that EPA's Cadence determination was "mistaken." CIS' Opening Brf. at 18. Primarily, Carbon Injection Systems asserts that the EPA Administrator made a *conceptual* mistake by failing to understand that injectants' net cooling effect on the furnace means they cannot be considered as providing substantial, useful heat. Second, Carbon Injection Systems argues that the EPA Administrator made a *factual* error in that new information shows that substantially less combustion of injectants occur in the blast furnace than previously known and thus injectants do not produce substantial, useful heat energy. At oral argument and in their post-argument brief, Carbon Injection Systems raises an additional factual argument disputing EPA's finding on substantial, useful heat – that the reaction of hydrocarbon injectants in a blast furnace raceway yields no heat.

1. *Resolution of This Case in Light of the Administrator's Determination on the Cadence Product*

This case does not arise in a vacuum. Far from it. As recounted above, the Administrator has previously determined that hydrocarbon injectants with substantial heating value provide substantial, useful heat when used in an iron blast furnace. Thus, we first determine whether Carbon Injection Systems' use of hydrocarbon injectants at the WCI blast furnace is distinguishable factually from use of the Cadence product in a blast furnace. Concluding that the Administrator's

Cadence determination is indistinguishable, we next consider Carbon Injection Systems' arguments claiming that the Cadence determination was mistaken.

We do not lightly undertake a review of the correctness of an Administrator's determination. Although the Board serves as EPA's "final decision making" authority in administrative proceedings under a host of environmental statutes administered by EPA, the Board exercises this authority under an express delegation *from the Administrator*. EPA Delegation of Authority 1-38A, Administrative Proceedings (Apr. 14, 2015); *see* Changes to Regulations to Reflect the Role of the New Environmental Appeals Board in Agency Adjudications, 57 Fed. Reg. 5320 (Feb. 13, 1992) (explaining that the rule creating the Environmental Appeals Board "reflects more clearly and directly the role of the Board as the final decisionmaker in Agency adjudications"). In carrying out its delegated functions, the Board treats its prior "final" decisions for the Agency as precedential, and they carry substantial weight in subsequent adjudications before the Board. It accords similar, if not greater respect, to prior authoritative decisions of the Administrator, who is the ultimate source of the Board's authority.

In the *1985 Burning of Waste Fuel Rule*, the Administrator issued decisions on how to interpret and apply the "burned to recover energy" criterion in the context of the use of the Cadence product in a blast furnace. Board precedents have consistently held that findings and interpretations made by the Administrator in a final rule preamble – such as the Administrator's interpretations and findings in the *1985 Burning of Waste Fuel Rule* – are authoritative decisions. *See In re Shell Gulf of Mex., Inc*. 15 E.A.D. 103, 130 (EAB 2010) (dismissing argument because petitioners failed to show "how their interpretation would be consistent with the Agency's authoritative interpretation published in the regulatory preamble"); *In re Mille Lacs Wastewater Treatment Fac.*, 11 E.A.D. 356, 369 (EAB 2004) (finding that "a regulatory preamble is the Agency's authoritative interpretation"); *In re Morton L. Friedman & Schmitt Constr. Co*., 11 E.A.D. 302, 328 (EAB 2004) (noting that "the courts view a regulatory preamble as an authoritative Agency interpretation of the regulation"). Thus, we grant substantial weight to the Administrator's interpretation and application of the "burned to recover energy" regulatory language in the Cadence determination, and approach Carbon Injection Systems' challenge to that determination with a caution appropriate to the respect the determination deserves.

In considering a challenge to an authoritative Administrator determination, the Board first inquires whether the underlying law, either statutory or regulatory, has changed since the prior determination. Absent a change in the law, our focus shifts to whether there have been other interpretational, operational, or factual

changes that are of such significance that the Board can best fulfill its delegated function as the Agency's final decisionmaker only by revising the Agency's prior position. Although not perfectly analogous, the Supreme Court's examination of challenges to prior precedent provides a useful guide for our analysis. The Supreme Court has summarized the relevant considerations as follows:

> [W]hen this Court reexamines a prior holding, its judgment is customarily informed by a series of prudential and pragmatic considerations designed to test the consistency of overruling a prior decision with the ideal of the rule of law, and to gauge the respective costs of reaffirming and overruling a prior case. Thus, for example, we may ask whether the rule has proven to be intolerable simply in defying practical workability; whether the rule is subject to a kind of reliance that would lend a special hardship to the consequences of overruling and add inequity to the cost of repudiation; whether related principles of law have so far developed as to have left the old rule no more than a remnant of abandoned doctrine; or whether facts have so changed, or come to be seen so differently, as to have robbed the old rule of significant application or justification.

Planned Parenthood v. Casey, 505 U.S. 833, 854-55 (1992) (citations omitted). Of these considerations, the most relevant to the present case, given Carbon Injection Systems' arguments, is examining the extent of change in the facts underlying the prior decision.

Certainly, EPA's ALJs have no greater authority than the Board in considering a challenge to prior Administrator decisions. EPA's ALJs are not delegated final decisionmaking authority for the Agency. In the context of contested enforcement proceedings under Part 22, that authority is delegated solely to the Board and may not be re-delegated. EPA Delegation of Authority 1-38A, Administrative Proceedings (Apr. 14, 2015). Such authority does not devolve to EPA's administrative law judges and regional judicial officers simply because

those decisions may become final orders of the Agency.[21] Nonetheless, because Part 22 tasks ALJs with making an "Initial Decision" in an enforcement case – essentially, a recommended decision for the Agency or the Board – an ALJ generally should follow a similar approach to examining prior Administrator decisions.

The ALJ did not do that here. Rather, the ALJ conducted what can best be described as a de novo review of how hydrocarbon injectants should be treated under EPA's and Ohio's hazardous waste regulations. The ALJ did not treat the Cadence determination as controlling precedent that needed to be distinguished if not followed, nor did she decide to depart from the Cadence determination only after finding that the circumstances had changed so dramatically as to warrant such a momentous step. Instead, the ALJ regarded the Administrator's Cadence determination as meriting no different weight than any of the other evidence before her. Init. Dec. at 82 ("looking to the highly technical determinations rendered by the Agency [in the Cadence determination] for guidance is less reasonable than relying upon the evidence presented by the parties in this proceeding"). Ultimately, the ALJ did not rely on the Administrator's Cadence determination because she concluded it was less "persuasive" than the testimony of Carbon Injection Systems' expert witnesses. *Id*. at 83.

Approaching this case from the correct starting point, we first summarize the Administrator's Cadence determination because of its centrality to the issues in this case. We then examine whether Carbon Injection Systems' hydrocarbon injectants are distinguishable from the Cadence product. Concluding that they are not, we turn to an evaluation of whether the ALJ erred in accepting Carbon Injection Systems' argument that the Administrator's Cadence determination was mistaken. In conducting this analysis, we accord substantial weight to the Administrator's decision and only would depart from it were we to conclude that "the facts have so changed, or come to be seen so differently, as to have robbed [the Cadence

[21] Under Part 22, the ALJ's Initial Decision would have become "final" if there was no motion to reopen or set aside the Initial Decision, no party appealed to the Board, and the Board did not elect to exercise *sua sponte* review of the decision. 40 C.F.R. § 22.27(c). However, even if the decision became "final" in this manner, it would not have been subject to judicial review, *id.* § 22.27(d), and it would not be considered a decision by the Board. *See* Consolidated Rules of Practice, 64 Fed. Reg. 40,138, 40,165 (July 23, 1999) (noting that the Board "is responsible for assuring consistency in Agency adjudications" and it does so through the "appeal process"). Thus, Part 22 contains no implied delegation of the Agency's final decisionmaking authority to an ALJ.

determination] of significant application or justification." *See Planned Parenthood,* 505 U.S. at 855.

2. *The EPA Administrator's Cadence Determination*

In the preamble to the *1985 Burning of Waste Fuel Rule*, the EPA Administrator responded to commenters who argued that the regulation should not cover a specific blast furnace injectant, marketed as "Cadence product 312." 50 Fed. Reg. at 49,171. Cadence product 312 was a mixture of "hazardous spent solvent recovery still bottoms and other hydrocarbon-based hazardous wastes" that was blended to yield a heating value of 10,500 to 14,000 BTUs/lb. *Id*. The commenters argued that hydrocarbon injectants were not burned for energy recovery, but were ingredients in the iron-making process to provide reducing gases to a blast furnace, and only provided "incidental and unavoidable" heat energy. *Id*. The commenters further asserted that hydrocarbon injectants have "the beneficial effect of cooling flame temperatures in the combustion zone of the furnace." *Id*.

EPA's response summarized, in a relatively abbreviated discussion (with references to leading technical handbooks), the heat consequences that result from the complex reactions of hydrocarbon injectants in blast furnaces. *Id*. at 49,171-49,173. In its response, EPA expressly articulated the Agency's view that injectants provide substantial, useful heat to a blast furnace when combusted in the raceway even if they have an overall cooling effect on temperatures in that part of the furnace. EPA explained that upon initial injection into the blast furnace, injectants "first behave as *bona fide* fuels, by combusting to (ideally) carbon dioxide and water [vapor]." *Id*. at 49,172. The "sensible heat" [22] released by this combustion, according to EPA, is a function of an "injectant's heating value in BTU/lb." *Id*. EPA noted that following the initial combustion of injectants, the combustion products (carbon dioxide and water vapor) are dissociated into the reducing gases, carbon monoxide and hydrogen. This chemical dissociation reaction results from the heat and presence of excess carbon in the raceway. EPA explained that the heat and reducing gases provided by injectants "drive [the chemical] reactions" necessary for iron ore reduction allowing blast furnace "operators to reduce coke rates." *Id.*

[22] Sensible heat is "thermal energy whose transfer to or from a substance results in a change in temperature." *Webster's Third*, at 2067.

EPA then elaborated upon the heat energy supplied to the blast furnace by injectants outside the combustion zone. As EPA explained, carbon monoxide and hydrogen reducing gases that do not react with iron ore as they ascend through the furnace are captured as they emerge at the top of the furnace, and used for various heat applications in the facility. EPA wrote:

> The heat energy released from subsequent (i.e., outside the combustion zone) reactions of fuel injectant hydrocarbons is in fact substantial, intentional, and useful contrary to Cadence's claim that it is incidental and unavoidable. As discussed above, furnace top gas is used as fuel in stoves to heat the hot blast, in a boiler plant, or in other heating applications within the steel plant. The excess reducing gas contained in the top gas that was not used to reduce the iron ore gives the top gas substantial heating value. The excess reducing gas is contributed by the coke and fuel injectants, roughly in proportion to the amount of hydrocarbons each provides to the furnace * * *.

Id. at 49,172-73. EPA concluded that injectants like Cadence with "substantial heating value" supply "substantial heat energy" to a blast furnace. *Id*. at 49,172.

Throughout this discussion, EPA described the nature of the reactions in the furnace in terms of whether the reactions are exothermic (release heat) or are endothermic (absorb heat).[23] Focusing first on coke, EPA explained that the burning of coke in the combustion zone (raceway) is exothermic. *Id*. (the hot blast "is injected into the bottom of the furnace to burn the coke to produce the heat and reducing gas"). According to EPA, the reducing gas produced by the combustion of coke (i.e., carbon monoxide) then rises through the furnace stripping oxygen from the iron ore in endothermic reactions. *Id*. ("[t]he carbon monoxide reduces the iron ore by (net) energy absorbing reactions to produce pig iron"). The carbon monoxide unused in reduction reactions, EPA noted, is captured as it emerges from the top of the furnace (the "top gas"), and is burned in exothermic reactions to heat the hot blast or other parts of the facility. *Id*. ("furnace gas is used as a fuel in stoves

[23] The scientific term "exothermic" is defined as "a process or chemical reaction that is accompanied by evolution of heat, for example, combustion reactions." *Hawley's Dictionary* at 546. The term "endothermic" is defined as "a process or change that takes place with absorption of heat and requires high temperature for initiation and maintenance. An example is production of carbon monoxide and hydrogen by passing steam over hot coke." *Id*. at 501.

to preheat the combustion air (i.e., the hot blast) * * * [or] as fuel in a boiler plant or in other heating applications within the steel plant").

EPA presented a similar, but more nuanced, description of the reaction of liquid hydrocarbon injectants in the blast furnace. EPA broke the reaction into three steps. First, the hydrogen in the liquid hydrocarbon is vaporized, and EPA explained this is an endothermic step because it requires the addition of energy. *Id.* ("fuels first undergo endothermic vaporization"). EPA stated that in the second step the hydrogen and carbon materials are combusted and "release substantial energy" in the form of "sensible heat." *Id.* (after vaporization of the injectant it undergoes "exothermic combustion to (ideally) carbon dioxide and water where sensible heat is released"). In the third step, the injectants' combustion products, carbon dioxide and water vapor, are then dissociated and reduced to carbon monoxide and hydrogen in an endothermic reaction. *Id.* (the carbon dioxide and water vapor undergo "endothermic dissociation and reduction in the presence of excess carbon provided by the coke to form the reducing gases carbon monoxide and hydrogen"). EPA described the "net reaction of injectants" in the combustion zone as "endothermic" and thus "actually cool[ing] flame temperatures." *Id.* EPA referenced the iconic Babcock and Wilcox text entitled, "Steam: Its Generation and Use,"[24] to support this conclusion. That text states in pertinent part:

> At temperatures above 3000F, some of the CO_2 [carbon dioxide] and H_2O [water] in the flue gases dissociates, absorbing heat in the process. At 3500F about 10% of the CO_2 in a typical flue gas dissociates to CO [carbon monoxide] and O_2 [oxygen] with a heat absorption of 4345 Btu/lb of CO formed, and about 3% of the H_2O disassociates to H_2 and O_2 with a heat absorption of 61,100 Btu/lb of H_2 formed. As the gas cools, the CO and H_2 dissociated recombine with the O_2 and liberate the heat absorbed in dissociation, so the heat is not lost. However, the effect is to lower the maximum actual flame temperature.

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[24] This text has been in continuous publication for 140 years and is in its 42nd edition. Babcock & Wilcox, Steam/its Generation and Use – 42nd Edition, http://www.babcock.com/library/pages/steam-its-generation-and-use.aspx (last visited Jan. 14, 2016). EPA cites to the 39th edition in the *1985 Burning of Waste Fuel Rule*. *See* 50 Fed. Reg. at 49,172 n.22.

Babcock & Wilcox, *Steam: Its Generation and Use* 6-7 (39th ed. 1978) [hereinafter Babcock & Wilcox]. Thus, Babcock and Wilcox explain the cooling effect from dissociation of carbon dioxide to carbon monoxide in terms of a reduction of the maximum flame temperature and not as an overall endothermic reaction. EPA also emphasized that the dissociation of an injectant's combustion products carbon dioxide and water vapor to carbon monoxide and hydrogen provides reducing gases as "ingredients to furnace reactions" that strip oxygen from iron ore in endothermic reactions. 50 Fed. Reg. at 49,172. Finally, EPA noted that injectants, similar to coke, contribute unused reducing gases (carbon monoxide and hydrogen) to the top gas, which is burned in exothermic reactions to heat, among other things, the hot blast. *Id*. at 49,173.

EPA concluded its individual descriptions of the exothermic/endothermic nature of the coke and hydrocarbon chemical reactions by discussing the relevance of this exothermic/endothermic classification to the substantial, useful heat question. EPA noted that although "net furnace reactions are endothermic," coke and injectants provide the heat as well as the reducing gases necessary to drive the overall net endothermic reactions that produce the iron ("hot metal") from the iron ore. *Id*. EPA stated that the net endothermic nature of the process does not mean that coke and injectants are not fuels producing "substantial needed [heat] energy." *Id*. After all, EPA pointed out, coke is "the primary fuel source to the furnace." *Id*.

3. *Carbon Injection Systems' Hydrocarbon Injectants Are Not Distinguishable from the Cadence Product*

The Administrator's determination on the Cadence product is not distinguishable from Carbon Injection Systems' use of hydrocarbon injectants in the WCI Steel blast furnace. In the *1985 Burning of Waste Fuel Rule*, EPA found that hydrocarbon injectants, like the Cadence product, with substantial heating value, release substantial, useful heat when injected into an iron blast furnace and thus qualify as being "burned to recover energy." 50 Fed. Reg. at 49,171-74. The Cadence product was blended so as to have values of between 10,500 to 14,000 BTUs/lb. *Id*. at 49,171. The contract between Carbon Injection Systems and WCI Steel required Carbon Injection Systems to provide Fuel Oil with significantly higher BTUs/lb values: 18,000 to 20,000 BTUs/lb. Product and Supply Agreement, CX 24 at EPA-13139. We are not aware of any claim made by Carbon Injection Systems that the alleged hazardous waste component of the Fuel Oil did not fall within this range; in fact, Carbon Injection Systems' own experts testified that the alleged wastes were suitable hydrocarbon materials for injectant use. ALJ Tr. at 2558 (describing alleged "waste" "oils" as "very rich in hydrocarbons" and "ideal materials in terms of being able to generate reducing gases essentially in the

blast furnace") (testimony of Dr. Poveromo). Neither has Carbon Injection Systems offered any significant justification for why the use of hydrocarbon injectants at WCI Steel should be regarded differently than the use of the Cadence product in blast furnaces.[25] Accordingly, we conclude that the Carbon Injection Systems hydrocarbon injectants are indistinguishable from the Cadence product with regard to whether they provide substantial, useful heat.

4. *Burning Hydrocarbon Injectants in the Raceway Provides Substantial, Useful Heat*

Because the present case is indistinguishable from the Administrator's determination on the Cadence product, we now consider Carbon Injection Systems' conceptual and factual challenges to the Cadence determination and evaluate whether the ALJ erred in deciding not to rely on the Administrator's determination. In conducting this analysis, we have separated the question of whether hydrocarbon injections produce substantial, useful heat in the furnace's raceway from whether injectant byproducts in the top gas are used to provide substantial, useful heat.[26] We have further subdivided the first of these questions, looking initially to whether injectants provide any heat to the raceway, and then turning to the question of

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[25] Carbon Injection Systems' expert Mr. Rorick presented information on the amount of hydrocarbon injectants combusted in the raceway that potentially presented grounds for distinguishing the use of hydrocarbon injectants in the WCI Steel blast furnace from their use in other furnaces. ALJ Tr. at 2397-2400, 2402-04 (testimony of Mr. Rorick). However, the larger thrust of Mr. Rorick's testimony on this point applied generally to blast furnaces, so we have addressed this issue in the context of Carbon Injection Systems' claim that hydrocarbon injectants do not provide substantial, useful heat. *See* Section V.E.4.b.(ii). Ultimately, we reject Mr. Rorick's testimony on the amount of hydrocarbon injectants combusted as unreliable, and, thus, his testimony does not provide a basis for distinguishing this case from the Cadence determination. *Id.*

[26] Because of the particular circumstances of this case, we are looking separately at the questions of whether hydrocarbon injectants provide substantial, useful heat in the furnace's raceway and whether they supply such heat from use of the top gas outside the furnace. As discussed in Section V.E.5., the ALJ held that the Region had not proved that the top gas *at the WCI Steel blast furnace* was used for heating purposes. We did not take *sua sponte* review over this issue because it was facility-specific and we could otherwise resolve the substantial, useful heat question. The decision not to take this issue for *sua sponte* review should not be interpreted as implying that the furnace's top gas is unimportant generally in assessing whether hydrocarbon injectants are burned for energy recovery. *See* 50 Fed. Reg. at 49,172-73.

whether any heat contribution made is substantial and useful. In this portion of the discussion, we will address specifically Carbon Injection Systems' arguments that the EPA Administrator's Cadence determination was both conceptually flawed (no net heat equals no substantial, useful heat) and factually wrong (a substantial amount of injectants are not combusted in the blast furnace and those that are reacted provide no heat).

a. *Carbon Injection Systems' Hydrocarbon Injectants Provide Heat*

In the Cadence determination, the Administrator concluded that hydrocarbon injectants acted as a *bona fide* fuel by being combusted in the blast furnace raceway to provide heat. While disagreeing with the characterization of the heat supplied by hydrocarbon injectants, the ALJ acknowledged that the combustion of hydrocarbon injectants in a blast furnace raceway provides some heat. Init. Dec. at 70, 83. In its initial briefs to the Board, Carbon Injection Systems also appears to concede this point. CIS' Opening Brf. at 28; Respondents Carbon Injection Systems LLC, Scott Forster and Eric Lofquist's Response Brief at 10 ("CIS' Resp. Brf.") at 10. However, at oral argument and in its post-argument brief, Carbon Injection Systems took the position that its injectants add no heat. Respondents Carbon Injection Systems LLC, Scott Forster and Eric Lofquist's Post-Oral Argument Brief at 2-3 ("CIS' Post-Arg. Brf."); EAB Hearing Transcript ("EAB Tr.") at 73, 77, 80-81. Thus, we begin our analysis of the substantial, useful heat issue with the preliminary question of whether Carbon Injection Systems' hydrocarbon injectants provide any heat at all.

(i) *Expert Witness Testimony at the Hearing*

The expert testimony at the evidentiary hearing consistently supports the Administrator's conclusion in the Cadence determination that hydrocarbon injectants release heat when combusted in the raceway. The expert who addressed this issue most directly was Dr. Richard Fruehan, who testified as a witness for the

Region. Dr. Fruehan is an impressively-credentialed witness[27] who was not seriously challenged by Carbon Injection Systems' experts on the critical chemistry and thermodynamics issues in this case.[28]

Dr. Fruehan emphasized in his testimony that the combustion of hydrocarbon injectants to carbon monoxide in the blast furnace raceway was an exothermic reaction releasing heat. On direct examination, Dr. Fruehan testified as follows:

> Q. Do the injectants provide those two types of energy [i.e., heat and chemical]?
>
> A. Yes.

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[27] Dr. Fruehan is an academician who holds the U.S. Steel-endowed chair at Carnegie-Mellon University in Metallurgy and Materials Science. ALJ Tr. at 1044; Vita: Richard James Fruehan, CX 93 at EPA-18489. His sub-specialty is in iron and steelmaking and other metals production, and he teaches courses on these subjects as well as on thermodynamics. ALJ Tr. at 1046 (testimony of Dr. Fruehan). In addition, Dr. Fruehan is the founder and co-director of the Center for Iron and Steelmaking Research, a research center founded with a grant from the National Science Foundation. *Id*. at 1046-47; Vita: Richard James Fruehan, CX 93 at EPA-18489. Dr. Fruehan has written numerous articles on ironmaking and related topics and is one of the associate editors of the peer-reviewed journal, Metallurgical and Materials Transactions B. Vita: Richard James Fruehan, CX 93 at EPA-18502 – EPA-18528. Dr. Fruehan also has served as a consultant to the U.S. Department of Energy and for iron and steelmaking companies around the world, and holds nine patents on the iron and steelmaking process. ALJ Tr. at 1054-56; Vita: Richard James Fruehan, CX 93 at EPA-18528 – EPA-18529. Finally, in addition to many other prizes and honors, Dr. Fruehan is a member of the National Academy of Engineers, a branch of the National Academies of Sciences. ALJ Tr. at 1045; Vita: Richard James Fruehan, CX 93 at EPA-18492.

[28] Carbon Injection Systems' expert on energy questions, Dr. Joseph Poveromo did not differ with Dr. Fruehan on the heat consequences of using hydrocarbon injectants, but rather on the interpretation of whether those heat consequences met the regulatory test of "substantial, useful heat energy." Carbon Injection Systems' expert on blast furnace operations, Mr. Rorick, differed with Dr. Fruehan on certain aspects concerning the operation of a blast furnace, including the relative amount of injectants combusted in the raceway, and the amount of carbon from injectants absorbed by the hot metal. *See* ALJ Tr. at 2406-08, 2437-40 (testimony of Mr. Rorick).

> Q. How do they provide that energy?
>
> A. Down in the bottom of the furnace where we inject the injectant, it can be carbon containing, it can contain hydrogen, we get off some initial heat by combusting the carbon portion to CO. That heat heats up the gases and according to the Respondents' energy and materials balances with the oxygen enrichment to about 3,500 degrees Fahrenheit.
>
> The gas – 50 percent of that is nitrogen, by the way, because of the air, and doesn't react. It just carries energy up the furnace.
>
> That [sic] gases leave the furnace at about 500 degrees Fahrenheit so the difference there of 3,000 degrees Fahrenheit, that energy is being transferred to the burden and being used in the process so that's the first way it provides energy.[29]

ALJ Tr. at 1083-84; *see also id*. at 1092 (testimony of Dr. Fruehan).

On cross-examination, Carbon Injection Systems' attorney directly confronted Dr. Fruehan with the description in the preamble to the *1985 Burning of Waste Fuel Rule* of the three-step reaction by which hydrocarbon injectants combust to carbon monoxide and hydrogen, 50 Fed. Reg. at 49,172, and questioned whether that process was exothermic. ALJ Tr. at 1176-81. At the same time, Dr. Fruehan unequivocally responded that the reaction itself was exothermic: "what I'm saying is the net reaction, carbon plus oxygen goes to CO is exothermic. The reaction itself is exothermic." *Id*. at 1177-78. Dr. Fruehan admitted that the heat generated may not be sufficient, absent oxygen enrichment, to raise the temperature of both the reaction byproducts (carbon monoxide and hydrogen) and the nitrogen in the hot blast air all the way up to raceway temperature of 3,500° F. *Id*. at 1159 ("[I]f you inject only air, you're heating up a lot of nitrogen but that's just absorbing the heat whereas if you have oxygen [enrichment], you don't have to heat up that nitrogen."). Carbon Injection Systems' attorney continued to press Dr. Fruehan on whether the three-step reaction of injectants EPA described was endothermic or exothermic, eliciting the following testimony:

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[29] Dr. Fruehan also testified extensively on how the carbon monoxide provides chemical energy necessary to driving the reduction reactions that strip oxygen from the iron ore. *See* ALJ Tr. at 1077-1102.

> Q. And if you look at all three steps together, is it your testimony that that is an, when looked at as a whole, an [sic] exothermic reaction?
>
> A. The reaction itself, just the reaction now, not heating up the components and –
>
> Q. The reaction itself.
>
> A. Is exothermic.
>
> Q. If you look at all three steps together?
>
> A. Yes.
>
> Q And is it your understanding that all of that happens within the raceway of the blast furnace?
>
> A. Yes.

ALJ Tr. at 1180-81. Thus, Dr. Fruehan was very clear: combusting hydrocarbon injectants to carbon monoxide is an exothermic reaction that adds heat to the blast furnace raceway.[30]

Carbon Injection Systems' experts did not challenge Dr. Fruehan's explanation of the chemical reaction involved in combusting carbon to carbon monoxide. To the contrary, they largely confirmed his conclusion that combusting hydrocarbon injectants adds heat. One of Carbon Injection Systems' experts, Mr.

[30] Dr. Fruehan's testimony was not "confusing" on whether the hydrocarbon injectant to carbon monoxide reaction is exothermic because of Dr. Fruehan's reference to oxygen enrichment. *Compare* Init. Dec. at 73. When Dr. Fruehan's testimony is considered in its entirety, Dr. Fruehan opined that the chemical reaction itself is exothermic even though the overall impact of injecting room temperature hydrocarbons into the super-heated environment of a blast furnace raceway is endothermic absent oxygen enrichment. ALJ Tr. at 1083-84, 1176-81 (testimony of Dr. Fruehan); *see* Section V.E.4.b.(ii), *infra*.

Frederick Rorick,[31] was asked directly whether the oxidation of carbon releases energy. He replied in the affirmative.

> Q. If carbon is oxidized, doesn't that also mean that energy is being released?
>
> A. When a carbon molecule changes state from carbon to a CO [molecule] or carbon to CO_2, which is probably a better example, that change in state of that, there is an energy release, that is correct. That's standard science.

ALJ Tr. at 2489-90. Mr. Rorick's testimony addressing the amount of hydrocarbon injectants combusted in the raceway also indirectly acknowledged that combusting injectants in that location adds heat. Mr. Rorick testified that it was important to monitor and control hydrocarbon injectants from burning at the tip of the injectant insertion lance in the tuyere because otherwise the injectants could "burn a hole inside of the furnace." *Id*. at 2430. He explained that he helped develop a "thermocouple temperature measuring system" that would "if you start generating combustion right in that section of the furnace and it starts to get too hot, that thermocouple will sense the increase in temperature and automatically cut off the injectant thereby protecting the furnace." *Id*. at 2431.

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[31] Mr. Rorick was qualified as an expert in ironmaking based on his long experience in operating blast furnaces. He operated the blast furnace for the Bethlehem Steel Corporation for 37 years. ALJ Tr. at 2353 (testimony of Mr. Rorick). During that time, Bethlehem Steel loaned him to solve blast furnace problems at other facilities, such as those run by U.S. Steel and Stelco. Since the closure of Bethlehem Steel in 2003, Mr. Rorick has acted as a consultant on ironmaking, serving as an "advisor and a technical expert regarding blast furnace operations for operations all around the world." *Id*. at 2354. He also is an instructor at McMaster University's intensive ironmaking course. *Id*. at 2361. Mr. Rorick was the 37th recipient of Thomas L. Joseph Award for lifetime achievement in the field of ironmaking. That award is presented by Association for Iron & Steel Technology, which is the successor to American Institute of Steel Engineers. *Id*. at 2354; *see* Declaration of Frederick Charles Rorick (Apr. 2, 2012), RX 103 at CIS02004. Mr. Rorick also is personally familiar with the WCI blast furnace and data on its operation. ALJ Tr. at 2364-65 (testimony of Mr. Rorick).

Dr. Poveromo, Carbon Injection Systems' principal energy expert,[32] did not testify directly on the question of whether burning hydrocarbons adds any heat to the raceway. Although Dr. Poveromo admitted that the combustion of hydrocarbons at room temperature is an exothermic reaction, the thrust of Dr. Poveromo's testimony was that hydrocarbon injectants added no "net" heat energy to the blast furnace – i.e., hydrocarbon injectants have an overall cooling effect on the raceway taking into account all of the factors bearing on the temperature in the raceway when injectants are substituted for coke. *Id*. at 2557 ("Q. Do you agree with Professor Fruehan that on balance, the injectants contribute heat energy to the reactions in the blast furnace? A. Oh, the whole point of this presentation is to really show that on a net basis they do not.") (testimony of Dr. Poveromo).[33] However, Dr. Poveromo submitted a declaration prior to the hearing before the ALJ, which is more illuminating on the issue of whether injectants add *any* heat to the raceway. In that declaration, Dr. Poveromo included the following table comparing the British thermal units per pound ("BTUs/lb") released in combusting coke, pulverized coal, oil, tar, and natural gas to carbon monoxide and other byproducts. That is precisely the reaction that occurs in the raceway. British thermal units ("BTUs") are a measure of the heat value of a substance or reaction. *Hawley's Dictionary*, at 188.

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[32] Dr. Poveromo received a doctoral degree in chemical engineering from the State University of New York at Buffalo. Resume: Joseph J. Poveromo, RX 52 at CIS00582. For over the last 20 years he has operated a consulting firm on ironmaking and worked with iron producers from around the world. *Id*. For the 20 years prior to that he worked in the research department at Bethlehem Steel Corporation. *Id*. He has published numerous articles on ironmaking and received many awards. *Id*. at CIS00583-91. Additionally, he has served as a developer of, and instructor at, McMaster University's intensive ironmaking course. ALJ Tr. at 2526-27 (testimony of Dr. Poveromo).

[33] *See* ALJ Tr. at 2545-46 ("[Hydrocarbon injectants] provide no net energy to the system when you consider the role of the reactant, the reaction products and the subsequent role they play in the process. The key word here is 'net energy.'"), 2555 ("Q. But even if we just limit the question to the raceway zone, do injectants produce heat and thermal energy in that zone? A. On a net basis, no, no."), 2571 ("Q. So are the oil injectants also an energy source to replace the energy that's no longer being supplied by coke? A. On a net basis, no. And that's the key point of this whole presentation.").

Stoichiometric Combustion of Fuels Based on One Mole of Injectant		
	Total moles/mole C	Btu/lb C
Coke: $C + ½ O_2 + 1.88 N_2 \rightarrow CO + 1.88 N_2$	2.880	3,963
Natural Gas: $CH_4 + ½ O_2 + 1.88 N_2 \rightarrow CO + 2 H_2 + 1.88 N_2$	4.880	1,279
Oil: $CH_{1.55} + ½ O_2 + 1.88 N_2 \rightarrow CO + 0.775 H_2 + 1.88 N_2$	3.655	3,563
Coal Tar: $CH_{0.65} + ½ O_2 + 1.88 N_2 \rightarrow CO + 0.325 H_2 + 1.88 N_2$	3.205	3,729
Coal: $CH_{0.64}$ ½ $O_2 + 1.88 N_2 \rightarrow CO + 0.320 H_2 + 1.88 N_2$	3.200	3,729

Declaration of Joseph J. Poveromo, RX 102 at CIS01997 (Mar. 29, 2012) [hereinafter Declaration of Dr. Poveromo].

In brief, what Dr. Poveromo's table shows is that in combusting these materials to carbon monoxide, coke releases the greatest amount of heat energy as measured in BTUs/lb; coal, oil, and coal tar release a slightly lower amount; and natural gas releases a substantially lower amount. Based on this table, Dr. Poveromo concluded that "because the heat released by the partial combustion of injectants is less than that for coke, while there are more products of combustion, there is insufficient heat to raise the temperature of the products of combustion to the temperature existing in the tuyere zone."[34] *Id*. at CIS01996. In other words,

[34] Dr. Poveromo's testimony and declaration principally focus on the cooling effect resulting from use of hydrocarbon injectants. His declaration explained that the extent of the cooling effect that injectants have on the raceway "is in the opposite direction as the heat released when the same hydrocarbons are combusted at room temperature." Declaration of Dr. Poveromo, RX 102 at CIS01997. In other words, an injectant's cooling effect is inversely proportional to the amount of heat it releases when combusted (i.e., an injectant's cooling effect lessens as the heat it releases increases and vice versa).

Dr. Poveromo is acknowledging that injectants release heat in the raceway. However, as he explained, that heat is insufficient alone to raise the injectant byproducts all the way up to the high temperature of the raceway. Dr. Poveromo testified that to restore raceway temperatures, blast furnace operators can reduce moisture in the hot blast, increase the temperature of the hot blast, and/or enrich the hot blast with oxygen to burn more coke. ALJ Tr. at 2547. This is consistent with Dr. Fruehan's explanation that the combustion of injectants in the raceway is exothermic, but may be insufficiently exothermic absent oxygen enrichment to generate enough heat to raise the byproducts to raceway temperatures.

That hydrocarbon injectants provide heat when combusted in the raceway is confirmed by two authorities relied upon by Mr. Rorick and Carbon Injection Systems generally. Frederick C. Rorick, *Technical Report on Blast Furnace Issues in the Matter of Carbon Injection Systems, LLC, et al. Docket No. RCRA-05-2011-0009* (undated), RX 108 at CIS02027 [hereinafter *Technical Report on Blast Furnace Issues*]. In his testimony, Mr. Rorick specifically referenced a recent textbook written by Maarten Geerdes entitled *Modern Blast Furnace Ironmaking: An Introduction*. ALJ Tr. at 2358; *see* Maarten Geerdes, Hisko Toxopeus, & Cor van der Vliet, *Modern Blast Furnace Ironmaking: An Introduction* (2d ed. 2009) [hereinafter *Modern Blast Furnace Ironmaking*]. Mr. Rorick asserted that Maarten Geerdes is "an expert in iron making" and described his textbook as "a very good primer on blast furnace operations." ALJ Tr. at 2358. Mr. Rorick quoted from the book in the slides that he used for presenting his testimony. Powerpoint Presentation: Testimony of Frederick C. Rorick, Jr., RDX4 at 26. In explaining the iron blast furnace process, the textbook repeatedly notes that the combustion of injectants, along with the coke, provides heat to the furnace. For example, in its opening description of the blast furnace process, the textbook states:

> The process starts with the hot blast through the tuyeres, which gasifies coke and coal in the raceway. The reactions of the coke create hot gas, which is able to melt the ore burden * * *. *In addition, a huge amount of heat is generated in the raceway from the combustion of coke and coal (or oil, natural gas).* The heat leads to a high flame temperature, which generally is in the range of 2000 to 2300 °C [roughly 3,600 to 4,200 °F].

Modern Blast Furnace Ironmaking, at 12 (emphasis added); *accord id*. at 11 ("The hot blast burns the fuel that is in front of the tuyere, which is either coke or another fuel that has been injected into the furnace through the tuyeres. This burning generates a very hot flame and is visible through the peepsites as the 'raceway.'"), 42 ("Coke particles circulate at very high velocity in [the raceway] while being

gasified together with injectants such as coal, oil and natural gas. * * * The temperature increases rapidly to over 2,000 °C [roughly 3,600 °F] due to the exothermic oxidation of coke and injectants."), 51 ("Coals are injected via lances into the tuyeres * * * [t]he volatile components are gasified and ignited, which causes an increase in the temperature.").

A second authority referenced by Mr. Rorick is the Association of Iron and Steel Engineers' two volume work entitled *The Making, Shaping, and Treating of Steel*. *Technical Report on Blast Furnace Issues*, RX 108 *at* CIS02027. The *Ironmaking Volume* in this work was edited by Dr. David Wakelin, who served as a consultant to Carbon Injection Systems and is described by Carbon Injection Systems as a "recognized ironmaking expert." CIS' Resp. Brf. at 8; *see Ironmaking Volume* at xi (detailing Dr. Wakelin's extensive background in ironmaking). Mr. Rorick recommended this book to "those inclined to have even a more complete understanding" of how a blast furnace works. *Technical Report on Blast Furnace Issues*, RX 108 at CIS02027. The *Ironmaking Volume's* description of the blast furnace process also states that hydrocarbon injectants provide heat:

> The blast furnace is a tall shaft-type furnace with a vertical stack superimposed over a crucible-like hearth. Iron-bearing materials (iron ore, sinter, pellets, mill scale, steelmaking slag, scrap, etc.), coke and flux (limestone and dolomite) are charged into the top of the shaft. A blast of heated air and also, in most instances, a gaseous, liquid or powdered fuel are introduced through openings at the bottom of the shaft just above the hearth crucible. *The heated air burns the injected fuel and much of the coke charged in from the top to produce the heat required by the process and to provide reducing gas that removes oxygen from the ore*.

Ironmaking Volume, at 725 (emphasis added).

Although Carbon Injection Systems' main argument throughout this litigation has been that hydrocarbons add no "net" heat to a blast furnace, at oral argument, Carbon Injection Systems' counsel asserted that the combustion of

injectants provides no heat at all.[35] Carbon Injection Systems' "no heat" claims, however, are neither supported by the testimony of its witnesses nor by well-established scientific principles. First, Carbon Injection Systems contends that Dr. Fruehan, as well as EPA in the preamble to the *1985 Burning of Waste Fuel Rule*, stated that the combustion of hydrocarbon injectants is an endothermic reaction, i.e., a reaction that absorbs rather than gives off heat. CIS' Post-Arg. Brf. at 3. Carbon Injection Systems provides no citation to support this claim as to Dr. Fruehan. Moreover, as the extensive quotations for Dr. Fruehan's testimony above show, he unequivocally and repeatedly described the combustion reaction of the hydrocarbon injectants to carbon monoxide and hydrogen as exothermic, and his testimony on this point is supported by Dr. Poveromo and Mr. Rorick. Carbon Injection Systems is correct in noting that EPA in the preamble to the *1985 Burning of Waste Fuel Rule* stated that the "net" effect of the reaction of hydrocarbon injectants in the raceway is endothermic. But EPA also emphasized that injectants supply substantial heat by burning as a "*bona fide* fuel" in the raceway. 50 Fed. Reg. at 49,172. Thus, in context, EPA's brief reference to the net reaction of injectants as endothermic provides little support to Carbon Injection Systems' claim that injectants supply no heat.

Second, in an attempt to provide a scientific rationale for its "no heat" claim, Carbon Injection Systems asserts that the hydrocarbon injectants are not combusted in the raceway, rather they are instantaneously dissociated into carbon and carbon monoxide, and thus provide no heat. EAB Tr. at 70-71("Dr. Poveromo testified that, in the blast furnace and at the temperatures that are in the raceway, they're not even combusted. They are immediately and instantaneously dissociated into carbon and to 2CO [two molecules of carbon monoxide]."") (argument of Ms. Eiber, counsel for Carbon Injection Systems). This reaction of the carbon in hydrocarbon injectants in the raceway, Carbon Injection Systems argues, is fundamentally different than the reaction of the carbon from coke in that location. Carbon Injection Systems claims that, while the carbon in injectants is dissociated, not

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[35] EAB Tr. at 73 ("If you look at just that [combustion] step alone, at the raceway temperature, [hydrocarbon injectants] provide no heat because they can't get to the point of dissociation until they are heated up."), 77 ("Dr. Poveromo says, there's no heat. There is no heat from that reaction that you gain in the raceway, even when you break it down to that middle [combustion] step, there's no heat."), 81 ("[A]ll of the heat comes from two places. It comes from coke that is being combusted, and it's coming from the hot blast air that's coming in through the tuyeres. There's no heat coming from these injectant materials.") (argument of Ms. Eiber, counsel for Carbon Injection Systems).

combusted, to carbon monoxide without providing heat, the carbon in coke is subdivided in such a way that some is combusted to provide heat and the rest is reacted to provide carbon monoxide. For example, at oral argument, counsel for Carbon Injection Systems argued that "[t]he injectants only substitute for the coke that's providing the reducing gas * * *. The coke that provides heat is not the same as the coke that's providing the reducing gases * * *." EAB Tr. at 101. In their post-argument brief, Carbon Injection Systems clarifies that "[w]hen injectants are used, more coke is *burned*. Less coke is used overall, but a greater proportion of that coke is used for heat energy, and less is used as a reductant." CIS' Post-Arg. Brf. at 4 (emphasis added).

There is, however, no support in the experts' testimony for any of these assertions. As to the claim that injectants are dissociated to carbon monoxide without releasing heat, the experts in this case described the reaction between the carbon from a hydrocarbon injectant and oxygen interchangeably as "burning,"[36]

[36] *See, e.g.*, ALJ Tr. at 1132-33 ("[W]hen the [hydrocarbon injectant] material is burned in the blast furnace, it gives energy in three different forms. The initial combustion * * * gives us heat energy * * *.") (testimony of Dr. Fruehan), 1153 ("burning is the conversion of an element from its elemental state to an oxidized state or oxidized state to a more oxidized state") (testimony of Dr. Fruehan); Declaration of Dr. Poveromo, RX 102 at CIS 01996 ("[W]hen a [hydrocarbon] fuel is injected into the blast furnace, it can only burn to carbon monoxide and hydrogen.").

"combusting,"[37] "oxidizing,"[38] or "reacting."[39] None described the combination of carbon and oxygen to form carbon monoxide as a "dissociation."[40] After all, "dissociation" is the process by which "a chemical combination breaks up into simpler constituents." *Hawley's Dictionary* at 471. Moreover, as noted earlier, Dr. Fruehan repeatedly stated that the reaction itself between carbon and oxygen (not heating up its byproducts to raceway temperatures) is exothermic, ALJ Tr. at 1083, 1092, 1180-81, which Dr. Poveromo did not challenge. Rather, Dr. Poveromo focused on the "net" impact of injecting "cold" hydrocarbon materials into the hot environment of the raceway. *Id*. at 2545-46 (testimony of Dr. Poveromo ("[Injectants] provide no net energy to the system * * *. The key

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[37] ALJ Tr. at 1083 ("[W]e inject the injectant, * * * we get off some initial heat by combusting the carbon portion to CO.") (testimony of Dr. Fruehan), 2550 ("Q. [A] hydrocarbon combining with oxygen, is that combustion? A. [T]he reaction with oxygen perhaps can be called combustion, it can be called burning but it's not critical to what we're talking about here.") (testimony of Dr. Poveromo), 2485 ("the more [hydrocarbon] you inject, there is a limited amount that can be combusted") (testimony of Mr. Rorick).

[38] ALJ Tr. at 1159 ("these injectants are going in at room temperature and the heat that's given off by their initial oxidation is not enough to get them back up to flame temperature") (testimony of Dr. Fruehan), 2493 ("[s]ome carbon is oxidized in the raceway") (testimony of Mr. Rorick).

[39] ALJ Tr. at 2544-45 ("[W]e're putting these [hydrocarbon injectant] materials cold into the furnace. The reaction with oxygen does produce CO and hydrogen gases * * *.") (testimony of Dr. Poveromo), 2486 ("Some of [the hydrocarbon injectant] will be reacted in the raceway.") (testimony of Mr. Rorick), Declaration of Dr. Poveromo, RX 102 at CIS01996 ("The reaction of oxygen with these injected hydrocarbons ultimately produces CO and H_2 gases.").

[40] Counsel for Carbon Injection Systems appears to be confusing the dissociation reaction that breaks carbon dioxide into carbon monoxide with the combustion reaction between carbon and oxygen. Evidence in this case differed on the sequencing of the reactions between carbon and oxygen to form carbon monoxide. Dr. Poveromo stated that due to the high heat and excess carbon in the raceway, the carbon in injectants (and presumably the carbon from coke) burns directly to carbon monoxide. Declaration of Dr. Poveromo, RX 102 at CIS01996. Dr. Fruehan testified that this reaction occurs in two stages, with carbon first combusting with oxygen to form carbon dioxide and the carbon dioxide then being dissociated to carbon monoxide due to the high heat and excess carbon in the raceway. ALJ Tr. at 1180. Neither expert, however, described the reaction as solely involving dissociation with no combustion occurring.

word here is net."), 2555 (testimony of Dr. Poveromo) ("Q. But even if we just limit the question to that raceway zone, do injectants produce heat and thermal energy in that zone? A. On a net basis, no, no.").

There is also no support in the record for Carbon Injection Systems' argument that the carbon in hydrocarbon injectants reacts to the hot blast in the raceway in a fundamentally different way than the carbon in coke. In fact, Carbon Injection Systems' own expert, Mr. Rorick, refuted such a notion. In his words, "once you get inside the process, the process has no way of knowing where a C[arbon atom] or an H[ydrogen atom] came from * * *. [T]here's no nametag on it to say I came from oil or I came from here." *Id.* at 2453. When a carbon or hydrogen atom becomes available, Mr. Rorick explained, "[t]he process only knows that it is there and it uses it." *Id.* He concluded: "the furnace doesn't know and actually doesn't care where that carbon and hydrogen came from." *Id.* Further, Carbon Injection Systems' claim that the carbon in coke is subdivided between that which provides heat and that which provides carbon monoxide also is contradicted by its experts. Coke may have two roles in the raceway – providing heat and carbon monoxide – but those roles are performed concurrently, not separately. As Dr. Wakelin concisely explained, "[o]xygen contained in the [hot blast] air combusts the coke to carbon monoxide, providing heat and reducing gas." *Characteristics of the Blast Furnace Raceway*, CX 13 at EPA-10114. In other words, a single combustion reaction produces both heat and reducing gases. Thus, the roles carbon plays in producing heat and reducing gases cannot be assigned to different and discrete carbon atoms from coke. Moreover, remembering Mr. Rorick's admonition that the furnace does not know nor care where the carbon comes from, not only does combusting carbon from coke produce heat and reducing gases, but reacting carbon from hydrocarbons produces the same results.

(ii) *Other Information Bearing on Heat*

Other evidence in the record also supports EPA's claim that Carbon Injection Systems used the hydrocarbon injectants to produce heat in its blast furnace. In 2008, EPA recorded the following statements of Mr. Bob Delost, the coordinator of the WCI Steel blast furnace operations, during an inspection of the WCI furnace:

> Mr. Delost said the injection of the fuel increase [sic] the temperature from approximately 1600F to 3300F. The injection point of the oil and natural gas is at the bottom of the furnace. The flame at the injection point moves up the furnace. He said the purpose of the injection [sic] to add heat value. He said there is a

> baseline BTU value of the fuel otherwise there would be a cooling reaction and they would be "totally screwed."

RCRA Compliance Evaluation Report: WCI Steel, Inc. (Sept. 25, 2008), CX 28 at EPA-16782. Mr. Pat Cannon from WCI Steel's purchasing department seconded Mr. Delost's comments on the use of injectants for their BTU value. *Id*. at EPA-16783.

At oral argument, Carbon Injection Systems' counsel claimed that these individuals were not the actual operators of the blast furnace. EAB Tr. at 105. No background information is provided on them in the inspection report. However, the detailed factual information from the coordinator of the blast furnace on temperature measurements and the position of the flame in the furnace carry some probative value.[41]

Accordingly, taking into account all of the above information, we conclude that the evidence in the record provides no basis to question EPA's determination that the combustion of injectants in the raceway by itself adds heat to the blast furnace. However, that does not end our inquiry, as EPA has interpreted the phrase "burned to recover energy" to require not just the generation of heat, but the generation of substantial, useful heat. We analyze that question next.

b. *Hydrocarbon Injectants Supply Substantial and Useful Heat*

At least as far back as 1985, industry representatives have contended that hydrocarbon injectants are used in blast furnaces solely as a source of reducing gases and not heat and thus should not be considered as materials "burned for

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[41] Carbon Injection Systems' credibility in arguing that hydrocarbon injectants do not provide heat is called into question by its federal income tax filings related to its hydrocarbon injectants. Carbon Injection Systems claimed an alternative fuel mixture credit of almost $10 million on its federal tax returns for the hydrocarbon injectants supplied to the WCI Steel blast furnace. Init. Dec. at 65. The relevant U.S. Internal Revenue Service ("IRS") notice defines an alternative fuel mixture as "[a] mixture [that] is used as a fuel when it is consumed in the production of energy* * *. [F]or example, a mixture is used as a fuel when it is consumed * * * in a furnace to produce heat." I.R.S. Notice 2006-92. It is inconsistent for Carbon Injection Systems to claim a tax credit from the IRS based on the proposition that the hydrocarbon injectants they supplied to WCI Steel "produce heat," and, at the same time, argue to EPA, a sister federal agency, that these hydrocarbon injectants produce no heat in the WCI Steel blast furnace.

energy recovery." 50 Fed. Reg. at 49,171. Despite the Administrator's rejection of this argument in the Cadence determination in the preamble to the *1985 Burning of Waste Fuel Rule*, Carbon Injection Systems renewed that claim in this litigation, and the ALJ found Carbon Injection Systems' position to be more "persuasive" than the Administrator's Cadence determination.

In reviewing the Initial Decision on this point, we focus first on the "substantial, useful heat" standard that the Administrator devised as a metric for determining if a material is "burned to recover energy." Second, once we determine how the substantial, useful heat standard should be interpreted, we address whether that standard was met for the hydrocarbon injectants supplied by Carbon Injection Systems to the WCI Blast Furnace. For the reasons discussed below, we conclude that there is no reason to disturb EPA's prior determination that burning of hydrocarbon injectants with high heating value in an iron blast furnace provides substantial, useful heat.

(i) *The Substantial, Useful Heat Standard*

As we noted earlier, EPA first articulated the substantial, useful heat standard in the *1985 Burning of Waste Fuel Rule* as a means for determining whether a material is "burned to recover energy." 50 Fed. Reg. at 49,167. Comments on the proposed rule expressed concern that the phrase "burned to recover energy" would apply when energy recovery from burning waste was "merely incidental." *Id*. Noting that since 1983 the Agency had stated that burning "low energy" wastes was not considered energy recovery, EPA responded that burning materials with organic constituents would not necessarily constitute energy recovery. Rather, EPA explained that a material is "burned to recover energy" only "where energy recovery is significant or purposeful." *Id*. Thus, EPA stated that energy recovery required more than "incidental energy release;" it required burning to recover "substantial, useful heat energy." *Id*.

EPA gave further content to the substantial, useful heat standard by explaining how the "burned to recover energy" language would apply to various materials based on the material's BTUs/lb value. EPA noted that the use of steam as an injectant in a blast furnace is not considered burning for energy recovery because steam has "no heating value." *Id*. at 49,173. Materials having a heating value below the range of 5,000 to 8,000 BTUs/lb, EPA stated, are regarded as "low energy fuels" and burning these fuels generally would not be considered as legitimate energy recovery. *Id*. at 49,166. However, EPA opined that if "low energy wastes" such as these were deliberately burned in "massive" amounts, then such burning would be treated as legitimate energy recovery because "larger

industrial boilers are more efficient at recovering energy and so could be deemed, more often, to be burning lower energy wastes legitimately." *Id*. Fuels with a minimum heating value of 5,000 to 8,000 BTUs/lb, according to EPA, are not low energy fuels. EPA stated that "[t]he Agency considers a material with a minimum heating value of 5,000-8,000 Btu/lb to be a *bona fide* fuel." *Id*. at 49,173 n.24. Finally, EPA concluded in responding to comments on the Cadence product that combusting a liquid hydrocarbon injectant with a heating value of 10,500-14,000 BTUs/lb in a blast furnace raceway generates substantial, useful heat. *Id*. at 49,171-49,173. Significantly, EPA in the Cadence determination focused on the heat hydrocarbon injectants contribute to the furnace and expressly rejected the argument that the "net" temperature effects from the use of injectants were controlling.[42] *Id*. EPA pointed out that focusing on net impacts could produce the counterintuitive conclusion that the primary fuel for a blast furnace, coke, was not in fact a fuel. *Id*.

Carbon Injection Systems conceptualizes the substantial, useful heat standard in the opposite fashion. As did the Cadence commenters in 1985, Carbon Injection Systems argues that the appropriate inquiry under the substantial, useful heat standard should be a relativistic one looking at the "net" heat impacts from using injectants. Dr. Poveromo and Carbon Injection Systems virtually ignore the heat energy injectants provide and instead focus on the relative or "net" negative impact that injectants' use has on raceway temperatures and the additional heat required to restore the raceway temperature to the 3,500 °F range. In his hearing testimony, Dr. Poveromo described injectants as having a "net" negative heat energy balance or as having an "endothermic" impact because after "taking into account the initial reactions of the injectants in the raceway * * * additional energy was needed to bring the * * * CO and the hydrogen, from the chemical reaction of each injectant, * * * up to raceway temperature * * *." ALJ Tr. at 2552; *accord id.* at 2545-46, 2555 (testimony of Dr. Poveromo). As Dr. Poveromo explained it, "[t]he big problem is that [injectants] are injected cold" into the 3,500° F raceway environment. *Id*. at 2544. Carbon Injection Systems argues that because combusting "cold" hydrocarbon injectants does not yield reducing gases at or

[42] We only present EPA's position in the preamble to the *1985 Burning of Waste Fuel Rule* here because the Region stated that it construes the preamble's statement that the use of injectants have an endothermic or cooling impact on raceway temperatures as meaning that injectants' combustion in the furnace does not provide substantial, useful heat. Region 5's Opening Brief at 29. As demonstrated *infra*, the Region has misinterpreted the preamble.

exceeding raceway temperatures this means that any heat provided by the combustion of injectants "is not truly exothermic, in the sense of actually providing sensible heat." CIS' Post-Arg. Brf. at 4. Carbon Injection Systems concludes that the net negative temperature effect that injectants have on the raceway should be decisive on the substantial, useful heat question, and that EPA erred by focusing solely on the heat provided by combusting injectants.

The ALJ largely adopted Carbon Injection Systems' argument that a material is not burned for energy recovery if its use has a negative net impact on furnace temperatures. According to the ALJ, the negative net heat balance resulting from the use of hydrocarbon injectants shows that they are not "a 'fuel' in the traditional sense," and thus "injectants generally do not appear to be 'fuels' as that term is used in the regulations at Ohio Admin. Code 3745-51-02(C)(2)(a)(ii)." Init. Dec. at 83. Based on her finding that "injectants do not appear to be 'fuels,'" the ALJ concluded that "a preponderance of the evidence fails to establish that materials injected into a blast furnace supply substantial and useful heat energy to the furnace upon initial combustion in the raceway." *Id*.

Despite the Board's specific request that the parties address the ALJ's reliance on "net" heat impacts in resolving this case, Carbon Injection Systems offers no reason why a net heat effect calculation is relevant to answering the substantial, useful heat question.[43] Instead, Carbon Injection Systems simply insists that external factors such as the preheating of the coke and the temperature of the raceway must be taken into account. For example, in its post-argument brief, Carbon Injection Systems argues that:

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[43] In its order designating issues for briefing on *sua sponte* review, the Board posed the following question:

> Did the hydrocarbon materials distributed by Carbon Injection Systems to WCI Steel, Inc., supply substantial, useful heat energy upon combustion in the raceway of WCI Steel's iron blast furnace? *Specifically, the Board requests that you address the ALJ's determination that the hydrocarbon materials supplied by Carbon Injection Systems did not contribute substantial, useful energy to the WCI Steel iron blast furnace "because of their net consumption of energy and consequential cooling effect in the raceway."*

Issues to be Briefed, at 2 (emphasis added).

> [EPA's] Cadence [determination] and Dr. Fruehan's descriptions fail to take into account the fact that this is all happening in the presence of carbon at raceway temperatures and the injectants are not preheated to those temperatures. *The raceway environment where the reaction occurs cannot simply be ignored*.

CIS' Post-Arg. Brf. at 4 (footnote omitted and emphasis added). Alternatively, to show that injectants do not provide substantial, useful heat, Carbon Injection Systems merely repeated the reasons why replacing pre-heated coke with "room temperature" injectants generates less heat in the raceway. For example, in its response brief to the Board, Carbon Injection Systems references the following explanation as showing why injectants do not provide substantial, useful heat:

> In concluding that this "combustion phase" [of the injectant] releases some sensible heat, U.S. EPA failed to take into account that these materials are injected at relatively low temperature. They must be brought up to raceway temperatures of 3700° to 3900° F during this phase in order for dissociation to carbon monoxide and hydrogen to take place. This requires more heat energy than can be supplied by the combustion of the injectants. Thus, to the extent there is even a brief "combustion phase," that phase alone is heat absorbing.

CIS' Resp. Brf. at 9 (as referenced by Carbon Injection Systems at page 10 of its brief). Reiterating the factors that cause use of hydrocarbon injectants to cool raceway temperatures (i.e., have a net negative heat energy impact), however, does not explain why a "net" approach is appropriate to resolving the question of whether hydrocarbon injectants provide substantial, useful heat. Carbon Injection Systems' arguments are essentially the same as the contentions commenters made on the Cadence product in the *1985 Burning of Waste Fuel Rule*. *See* 50 Fed. Reg. at 49,171. However, to convince the Board to reverse a determination from the Administrator, a party must do more than repeat arguments that the Administrator previously considered and rejected.

The ALJ also failed to offer a persuasive reason for overturning the Administrator's previous rejection of the use of a net heat approach to resolving the substantial, useful heat question for hydrocarbon injectants. The only reason the ALJ appeared to give for relying on a net heat approach is that it would be "less reasonable" to rely on the Administrator's "highly technical determinations" in the *1985 Burning of Waste Fuel Rule* than the evidence presented at the evidentiary hearing. Init. Dec. at 82. But even if the ALJ were correct in her conclusion

regarding the purported factual difference between the Administrator's and Dr. Poveromo's views on the endothermic impact of hydrocarbon injectants, which she is not, any such *factual* difference on "technical findings" is not relevant to the *legal* determination of the proper interpretation and implementation of the substantial, useful heat standard. In other words, the question of whether the substantial, useful heat standard should be applied by focusing on net heat impacts is conceptually different than the question of what net heat impact is attributable to any particular injectant. The Administrator was quite clear in his conclusions both that hydrocarbon injectants have a cooling or endothermic impact on furnace raceway temperatures and that this fact was irrelevant to whether the injectants produced substantial, useful heat. 50 Fed. Reg. at 49,172-73. The Administrator found that a focus on net impacts obscured rather than clarified the heat contribution of materials added to a blast furnace. *Id*. Neither Carbon Injection Systems nor the ALJ seriously engaged this latter conclusion.

The ALJ's reasoning that use of a material that results in a "net consumption of energy" is not "a 'fuel' in the traditional sense" also does not provide justification for overturning the Administrator's rejection of reliance on a net heat approach. *See* Init. Dec. at 83. Essentially, the ALJ has substituted a "traditional fuel" test for the Administrator's substantial, useful heat standard, and has applied this new test relying on a consideration – net heat impacts – that the Administrator explicitly rejected. Yet, the ALJ provided no reason for why the term "traditional fuel" should be treated as the *sine qua non* of a material that produces "substantial, useful heat," and no explanation of why a material's net energy impact on a process should be the definitive characteristic of whether the material is a "traditional fuel."

Moreover, the ALJ relied upon questionable support for the conclusion that injectants are not a "traditional fuel" due to "their net consumption of energy and consequential cooling effect in the raceway." *See Id*. at 82-83. The ALJ cited to a paper by two engineers, Rudolf Jeschar and Gerrit Dombrowski, concluding that hydrocarbon injectants should be regarded as a "chemical raw material" and not a "fuel" in a blast furnace. *Id*. at 77-78; *see* Rudolf Jeschar & Gerrit Dombrowski, *Summary Evaluation and Assessment of Carbon and Hydrocarbon Raw Materials for Iron Ore Reduction, 1998 ICSTI/Ironmaking Conference Proceedings* 431-441, RX 96 at CIS01606-16 [hereinafter Jeschar & Dombrowski]. The authors postulate that a substance is not an energy source unless its role in a manufacturing process could be replaced by an alternative energy source. Because hydrocarbon injectants both provide energy and become physically involved in the chemical reactions in the furnace, the authors conclude that hydrocarbon injectants are not fungible with other energy sources and thus are not an energy source for a blast furnace. *Id*.

at CIS01614. The paper states that the question of whether hydrocarbon injectants are a fuel or chemical raw material "is of particular importance for materials such as heavy oil and granulated plastics which are injected via the tuyeres of a furnace as the classification of such materials depends on this assessment with regard to energy tax, the tax *on injection oil and the injection of plastics*." *Id*. at CIS01606-07.

The Jeschar and Dombrowski paper does not support using a net heat approach for resolving whether injectants are a "traditional fuel" and thus provide substantial, useful heat. Like the ALJ, the Jeschar and Dombrowski paper concludes that hydrocarbon injectants are not "fuels" in an iron blast furnace. But the rationale for the Jeschar and Dombrowski conclusion – that injectants are not a fuel because of their critical role in a furnace's chemical iron-reducing reactions – is unrelated to the ALJ's finding that injectants are not a fuel because of the cooling effect they have on raceway temperatures. *Compare id*. at CIS01613-15 *with* Init. Dec. at 82-83. The ALJ concluded that hydrocarbon injectants cool the raceway because the heat they release "is exceeded by the amount of [heat] energy required to raise the temperature of the injectants to that of the raceway." Init. Dec. at 70. The ALJ did not link hydrocarbon injectants' cooling effect on the raceway to injectants' participation in iron-reducing reactions – reactions that occur in portions of the furnace other than the raceway. Nor did Jeschar & Dombrowski rely on the cooling effect of injectants to buttress their conclusion that hydrocarbon injectants are not fuels. Thus, the Jeschar and Dombrowski paper provides no support for the ALJ's holding that hydrocarbon injectants are not "fuels" supplying substantial, useful heat "because of their net consumption of energy and consequential cooling effect in the raceway." *Id*. at 83.

We also conclude that the ALJ erred to the extent she relied on this paper as potentially showing that the factual basis underlying the Administrator's Cadence determination has "so changed, or come to be seen so differently, as to have robbed [the Cadence determination] of significant application or justification." *See Planned Parenthood*, 550 U.S. at 855. First, the paper did not examine the specific issue involved in the Cadence determination or this case. EPA has made clear that in determining whether a material is burned to recover energy, the inquiry should *not* be directed at whether energy recovery is the sole, or even the "most important," "predominant," or "principal," purpose for which the substance is used. 50 Fed. Reg. at 49,167. Rather, the inquiry should focus simply on whether one of the purposes for its combustion is to provide substantial, useful heat energy. *Id*. Jeschar and Dombrowski, however, expressly state that their paper was directed at assessing "whether the carbon and hydrocarbon carriers used for the reduction of iron ore represent *in the main* chemical raw materials or fuels from a scientific and technological point of view." *Id*. at CIS01606 (emphasis added).

Whether materials are "in the main" chemical raw materials or fuels is important, Jeschar and Dombrowski note, for determining the application of an "energy tax." *Id*. Thus, not only were Jeschar and Dombrowski examining an "energy tax" question and not the scope of RCRA jurisdiction as it applies to recycled materials, but by focusing on the *primary purpose* for use of carbon-based materials in a furnace, Jeschar and Dombrowski answer a question that the Administrator expressly rejected as relevant to applying the "burned to recover energy" language.

Second, the overall result reached in the paper is so extraordinary that it undermines any individual conclusion regarding hydrocarbon injectants. The paper addresses not just hydrocarbon injectants, but all carbon-based materials used in a blast furnace. Based on their finding that carbon and hydrocarbon carriers are "physically involved in the [chemical] reactions" in a blast furnace and thus "cannot be replaced by another perhaps chemically inert energy carrier or other non-physical energy source," the authors assert that both coke and hydrocarbon injectants "cannot be classified as fuels." *Id*. at CIS01614-CIS01615. Rather, Jeschar and Dombrowski conclude that "[t]he carbon and hydrocarbon carriers such as coke, coal dust, heavy oil and granulated plastics which are used in the reduction of iron ore are therefore to be regarded as chemical raw materials." *Id*. However, the conclusion that coke is not a fuel or energy source in a blast furnace is expressly contradicted by the record in this proceeding. The preamble to the *1985 Burning of Waste Fuel Rule*, Dr. Fruehan, and the many industry and government organizations cited by Dr. Fruehan, all described coke as the primary energy source for a blast furnace. 50 Fed. Reg. at 49,172, 49,173 (noting that coke "is the primary fuel source to the furnace"); ALJ Tr. at 1069-70 (testimony of Dr. Fruehan) (explaining that the energy for a blast furnace is based on the carbon-based materials used in the furnace); *id.* at 1069-70, 1107, 1139, 1187 (testimony of Dr. Fruehan) (noting that industry and governmental organizations that calculate the energy used in a blast furnace based on the carbon-based materials used). Carbon Injection Systems' witness on the energy aspects of blast furnaces, Dr. Poveromo, explicitly stated that "of course coke is the major energy source of the blast furnace." *Id*. at 2538. And Carbon Injection Systems' consultant Dr. Wakelin, concurred: "the energy required in the blast furnace comes primarily from the burning of coke and not from the heat contained in the hot blast." *Characteristics of the Blast Furnace Raceway*, CX 13 at CIS10113.[44] Given that the grounds for

[44] Both of the reference books cited by Mr. Rorick also stress that one of the main roles of coke in a blast furnace is as a fuel to heat the burden. *Ironmaking Volume* at 727; *Modern Blast Furnace Ironmaking* at 37.

the authors' conclusion on the energy value of hydrocarbon injectants is identical to the grounds for concluding that coke is a chemical raw material and not a fuel, we do not find that the Jeschar and Dombrowski paper persuasively shows that facts underlying the Cadence determination have so changed as to rob it of any justification.[45]

In addition to the failure of Carbon Injection Systems or the ALJ to offer any compelling circumstances for abandoning the Administrator's approach to applying the substantial, useful heat standard to hydrocarbon injectants, this case has brought to the fore two significant problems with relying on a "net" heat approach to determine whether a material supplies substantial, useful heat. Importantly, the net heat approach is not faithful to the substantial, useful heat standard as articulated in the preamble to the *1985 Burning of Waste Fuel Rule*. As the Administrator explained, the substantial, useful heat standard is used to differentiate "low energy fuel[s]" (or fuels with "minimal heating value") that provide "incidental heat energy" from those that provide "significant or purposeful" heat energy. 50 Fed. Reg. at 49,167, 49,173. Thus, at its most basic, the substantial, useful heat standard focuses on the amount of heat a fuel provides

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[45] The Board further notes that the Jeschar and Dombrowski paper has neither been published in the public literature nor peer-reviewed. Init. Dec. at 77-78. EPA's Data Quality Guidelines emphasize the importance of peer review in the Agency's effort to "address the quality, objectivity, utility, and integrity of information." U.S. EPA, EPA/260R-02-008, *Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity of Information Disseminated by the Environmental Protection Agency* 10 (Oct. 2002). EPA's Peer Review Policy recommends that "major scientifically and technically based work products (including scientific, engineering, economic, or statistical documents) related to Agency decisions should be peer-reviewed." *Id.* at 11. The ALJ was correct in noting that a lack of peer review does not indicate that a study's conclusions are in error, *see* Init. Dec. at 78, and the Agency frequently and appropriately relies on non-peer reviewed data. But peer review, or lack thereof, takes on heightened importance here given that the question is whether the facts have so changed as to rob the Cadence determination of its justification, and the ALJ is relying on this study to support a key aspect of this dramatic reversal of factual understanding. We further note that Dr. Fruehan expressed fundamental objections to the conclusions and analysis in the paper. For example, as to Jeschar's and Dombrowski's central claim that the energy from coke and hydrocarbon injectants is "chemically bonded into the hot metal," Jeschar & Dombrowski, RX 96 at CIS01612, Dr. Fruehan retorted: "There is no such thing according to conventional thermodynamics as understood by the rest of the world." ALJ Tr. at 1116. Peer review would have allowed such objections to receive a fuller airing. Accordingly, the ALJ should have given more weight to the lack of peer review in this case.

compared to the overall fuel needs of the facility. For example, in a boiler or industrial furnace, if a replacement fuel has the capacity to provide more than an incidental or minimal amount of heat needed to operate the boiler or furnace, and the heat from the combustion of the fuel is actually used in the operation of the furnace, then the fuel would qualify as providing substantial, useful heat.

Conversely, the focus of the net heat approach is quite different. A net heat test compares the heat or temperature of a system using one fuel, with the new heat or temperature that results if a replacement fuel is substituted for the existing fuel. Under the net heat approach, if the temperature declines with the fuel substitution, the substituted fuel is judged not to provide substantial, useful heat because it results in a negative net heat balance. Only if the temperature increases upon substitution would the replacement material be deemed to provide substantial, useful heat. Thus, the net heat test does not recognize that a replacement fuel that *substantially* replaces the heat provided by the replaced fuel can qualify as providing substantial, useful heat. Rather, only a replacement fuel that more than *totally* replaces the heat from the replaced fuel would pass the net heat test.

The net heat test virtually turns the substantial, useful heat standard on its head. It no longer is directed at distinguishing "significant or purposeful" heat recovery from incidental heat recovery; rather, applying the substantial, useful heat standard under a "net" heat approach only identifies those fuels that supply at least as much, if not more, heat than existing fuels. In essence, the net heat test converts the substantial, useful heat standard from a means of excluding low energy fuels from the phrase "burned to recover energy," to a way of limiting the "burned to recover energy" requirement to fuels that have a heat impact exceeding fuels previously or otherwise used. As to injectants in a blast furnace, the heat contribution of the injectant is subordinated to consideration of the impact from the BTUs/lb of coke, the preheating of coke, and existing raceway temperatures. This tendency of the net heat approach to mask or obscure the heat contribution of a particular ingredient is precisely why the Administrator rejected it as an appropriate way of judging whether materials added to a blast furnace supply substantial, useful heat. 50 Fed. Reg. at 49,173. As the Administrator noted, because iron reduction is an overall net endothermic process, a net heat approach would conclude that the primary fuel in the blast furnace, the coke, is itself not a fuel. *Id*.

A second problem with the net heat test is that it produces arbitrary results. The relativistic nature of the net heat approach means that the benchmark for "substantial, useful heat" will be constantly shifting depending on the circumstances in which the substantial, useful heat question is being examined. A net heat approach takes into account all of the variables affecting temperature

changes in a system. Of particular importance among these variables is the type of material being replaced by the material being evaluated under the substantial, useful heat standard. If the material being replaced is coke in a blast furnace, the substantial, useful heat standard is an extremely demanding one given both the preheating and high BTUs/lb content of the coke. On the other hand, if the replaced material has a low BTUs/lb value, such as biomass from agricultural waste, and/or is not preheated, the level of the substantial, useful heat standard would drop dramatically. In fact, this relativistic approach could yield different answers to the substantial, useful heat question for the same replacement material in the same facility depending on what material in the facility is being replaced.

Nowhere is this better illustrated than with liquid hydrocarbon injectants in a blast furnace. Replacing preheated coke in a blast furnace with a "cold" liquid hydrocarbon injectant will, as this litigation has shown, result in a net negative heat impact in the furnace. If the net negative heat test is outcome determinative, the injectant would be found not to provide substantial, useful heat. However, the result would be the opposite in the same blast furnace if the liquid hydrocarbon injectant was used as a replacement for a natural gas injectant. Dr. Poveromo provided the following table, which shows that because natural gas generates less heat than oil upon combustion, natural gas has a greater cooling effect on a furnace's raceway than oil. (The table's positive numbers indicate an endothermic effect on raceway temperature and the negative figures show an exothermic effect.[46] ALJ Tr. at 2552-53; Declaration of Dr. Poveromo, RX 102 at CIS01999.)

Heat Effects at [Reference Adiabatic Flame Temperature] of 3500° F and Blast Temperature of 1800° F	
Reactions	Heat Effect Btu/mole of carbon
Coke with Air	-12,640
Coke with Moisture	+81,090
Natural Gas with Air	+83,625
Oil with Air	+29,530
Coal Tar with Air	+14,055
Coal with Air	+14,050

[46] In the table, the coke is presumed to be preheated to a temperature of 2800° F. Declaration of Dr. Poveromo, RX 102 at CIS01998.

Id. at CIS 01999. Thus, under a net heat approach, substituting oil (i.e., a liquid hydrocarbon) for natural gas in a blast furnace would yield a positive net heat balance and a positive answer to the question, "does a liquid hydrocarbon injectant provide substantial, useful heat?" Ironically, Mr. Rorick testified that at the WCI Steel blast furnace, Carbon Injection Systems' liquid hydrocarbon materials were a replacement for natural gas as an injectant. ALJ Tr. at 2495 (testimony of Mr. Rorick).[47] Thus, a rigorous application of Carbon Injection Systems' own net heat test to the WCI blast furnace would result in a finding that the adoption of liquid hydrocarbon injectants did supply substantial, useful heat.

For all of the above reasons, the ALJ erred in relying on a net negative heat balance to determine whether Carbon Injection Systems' hydrocarbon injectants were burned for energy recovery within the meaning of the *1985 Burning of Waste Fuel Rule*, instead of the substantial, useful heat standard articulated by the EPA Administrator in the rule's preamble. Focusing instead on how much heat injectants add and what purpose that heat serves is much more probative of whether injectants provide substantial, useful heat. We do that below.

(ii) *Hydrocarbon Injectants Provide Substantial, Useful Heat Upon Combustion in the Raceway*

To evaluate whether hydrocarbon injectants supply substantial, useful heat to a blast furnace raceway, we begin by reviewing the evidence on precisely what occurs in the raceway. As summarized earlier in Section V.E.4.a.(i), there appears to be no significant disagreement among the experts that at least some portion of the hydrocarbon injectants are combusted in the raceway and release heat raising the temperature of the combusted products above the temperature at which they were injected. The experts also agreed that the use of hydrocarbon injectants had an endothermic or cooling effect on raceway temperatures because injectants were inserted at room temperature as a replacement for preheated coke.

Intuitively, this description of what happens in the raceway makes sense. Two carbon-based materials – coke and hydrocarbon injectants – are introduced into the same, very hot environment in the presence of oxygen. Both materials combust, at least partially, forming the reducing gas carbon monoxide and releasing

[47] During Region 5's inspection of the WCI Steel blast furnace, a purchasing agent for WCI Steel confirmed that the oil from Carbon Injection Systems was used to replace natural gas. RCRA Compliance Evaluation Report: WCI Steel, Inc. (Sept. 25, 2008), CX 28 at EPA-16783.

energy in the form of heat. Other things being equal, any difference in heat supplied by the combustion of the materials in the same environment will be a factor of any differences in their BTU values and the beginning temperature of the materials at the point of combustion.[48] The record in this case supplies both of those values.

The table from Dr. Poveromo's declaration, presented above, separately lists the heating values in BTU/lb for burning coke, as well as various injectants, to carbon monoxide – the reaction that occurs in the raceway due to the high heat that makes carbon dioxide unstable. Declaration of Dr. Poveromo, RX 102 at CIS01997. That table shows that hydrocarbon oil injectants have similar heating values to coke (3,963 BTUs/lb of carbon for coke and 3,563 BTUs/lb of carbon for oil). *Id.* This relatively small difference in BTUs/lb between coke and liquid hydrocarbons contrasts with the significant temperature difference between coke and injectants as they enter the raceway. Coke descends into the raceway through the ascending hot gases and is preheated to a temperature of approximately 2,800° F. ALJ Tr. at 2541, 2542 (testimony of Dr. Poveromo). By comparison, injectants are added to the blast furnace at roughly room temperature. *Id*. at 1159 (testimony of Dr. Fruehan), 2544 ("[W]e're putting these [hydrocarbon injectant] materials cold into the furnace.") (testimony of Dr. Poveromo). Thus, preheated coke clearly will add more heat to the raceway than cold injectants, principally due to their differences in temperature, but also to some extent due to coke's higher heating (BTUs/lb) value.[49] *Id*. at 2544 (testimony of Dr. Poveromo); Declaration of Dr. Poveromo, RX 102 at CIS01996. After all, preheated coke brings an almost 2,800° F advantage with it to the raceway, as compared to hydrocarbon injectants. Accordingly, when cold injectants replace some portion of the pre-heated coke, raceway temperatures will decline unless some compensating action is taken.

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[48] Babcock and Wilcox explain that the flame temperature from combustion is a factor of the heat from combustion (generally measured in BTUs), the sensible heat in the fuel at the time of combustion, and the sensible heat of the air in the combustion chamber. Babcock & Wilcox, at 6-6 – 6-7.

[49] In fact, Dr. Poveromo admitted that liquid hydrocarbon materials could play the same role as coke in heating the furnace if they were inserted at the top of the furnace and could be preheated before entering the raceway. In answer to the question "[w]hy don't injectants help perform the energy role that coke plays?," he replied, "[t]he big problem is because they're injected cold into a blast furnace * * *. If you had some way to get the injectants into the top of the furnace and somehow preheat them up to raceway temperature, then indeed they could provide an energy role * * *." ALJ Tr. at 2544.

With the basic facts resolved, the second step in our inquiry is to determine whether a blast furnace replacement for coke – here, a hydrocarbon injectant – that does not fully heat up its combustion products to raceway temperatures provides substantial, useful heat to the blast furnace. Several factors indicate that a hydrocarbon injectant does provide such heat. Dr. Fruehan's testimony corroborates EPA's conclusion in the 1985 preamble that liquid hydrocarbon injectants provide substantial, useful heat. He repeatedly stated that the combustion of injectants provides an "awful lot of energy" toward getting the combustion byproducts up to raceway temperatures. ALJ Tr. at 1140; *see also id.* at 1097 (testimony of Dr. Fruehan). To the extent that the injectants do not supply heat energy, that heat energy would have to be supplied by another source. Plainly, the heat from injectants is useful to the furnace even if it is not a total replacement of the heat energy produced by combusting preheated coke.

Information contained in declarations Carbon Injection Systems submitted to the record further confirms the correctness of the Administrator's conclusion regarding the Cadence product. First, as noted above, Dr. Poveromo included information in his declaration showing that combusting hydrocarbon oil injectants to carbon monoxide supplies 85 to 90 % of the heat measured in BTUs/lb as does combusting coke in a similar manner. In other words, when coke burns in the raceway, the heat energy released from the combustion itself (i.e., excluding the underlying heat of the material) is only slightly higher than the heat energy released from a hydrocarbon oil injectant. Granted, the coke has a much greater impact on raceway temperature because the coke has been preheated. But that preheating comes from other sources – the hot blast and the prior combustion of other pieces of coke and injectants in the raceway. Thus, the actual heat contributed by an oil injectant is similar to that contributed by coke, and Dr. Poveromo admitted that coke is the primary fuel in the furnace. ALJ Tr. at 2538. Moreover, Dr. Poveromo acknowledged that if hydrocarbon injectants could be preheated, "[t]hey would then act just like coke, * * * [and] [t]hey'd be a net energy contributor." *Id*. at 2547; *accord id.* at 2544.

Dr. Poveromo's comparison of the cooling effects of various hydrocarbon injectants and Dr. Wakelin's comparison of use of steam versus hydrocarbon injectants also support EPA's conclusion that hydrocarbon injectants provide substantial, useful heat. As discussed above, in his declaration, Dr. Poveromo explained that the degree of the cooling effect from injecting hydrocarbons at room temperature into the raceway is inversely related to the amount of heat generated when the hydrocarbons are combusted. Declaration of Dr. Poveromo, RX 102 at CIS01999. A hydrocarbon such as natural gas, which provides the least heat upon combustion among the hydrocarbon injectants, has the greatest cooling effect.

Id. Hydrocarbon injectants, such as oil – essentially the equivalent of the liquid hydrocarbons in this case – and pulverized coal, that are more exothermic when combusted than natural gas, have a significantly less substantial cooling effect. Figures presented by Dr. Poveromo indicate that the cooling effect of natural gas is more than double that of oil and more than five times that of pulverized coal. *Id*. In other words, because the heat contributed by oil and pulverized coal is significantly greater than the heat from natural gas, less additional heat is needed to get oil and pulverized coal combustion byproducts up to raceway temperatures than for natural gas.

Presumably, the amount of additional heat needed is that much more when an injectant is used, such as steam, which cannot be combusted to produce heat. In his statement in the record, Dr. Wakelin contrasted use of steam as an injectant with the use of hydrocarbon injectants. *Characteristics of the Blast Furnace Raceway*, CX 13 at EPA-10114. Dr. Wakelin stated that use of injectants originated as a way to cool raceway temperatures that had gotten too hot as hot blast stoves had become more efficient. According to Dr. Wakelin, steam was initially used as a cooling injectant. Steam also served the purpose of providing reducing gases. In the presence of the high heat of the raceway and the carbon from the coke, steam (H_2O) reacts to form the gases, carbon monoxide and hydrogen. *Id*. The drawback to the use of steam, Dr. Wakelin explained, was that it had the "net effect" of increasing "the amount of coke required in the furnace to supply the energy for the cracking of the steam."[50] *Id*. Essentially, steam worked too well as a "coolant," and more coke had to be combusted to overcome steam's cooling effect. Dr. Wakelin noted that hydrocarbon materials were developed as "[m]ore cost effective tuyere injectants than steam." The obvious difference between steam and hydrocarbon injectants is that while both steam and the hydrocarbon injectant combustion products (carbon dioxide and water vapor) need to be "cracked" to yield the reducing gases carbon monoxide and hydrogen, only hydrocarbons provide a portion of the heat necessary to achieve that cracking and to raise the resulting reducing gases to raceway temperatures. Thus, hydrocarbon injectants require the combustion of less coke for heating purposes and are more "cost effective" than steam. In other words, hydrocarbon injectants provide substantial, useful heat not supplied by an injectant such as steam.

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[50] In chemistry, the term "crack" is used to mean "to break up into simpler compounds usually as a result of heating." *Webster's Third*, at 527.

In conclusion, the record before the Board shows that hydrocarbon injectants, such as the Cadence product and the injectants supplied by Carbon Injection Systems to WCI Steel, are combusted in the blast furnace raceway and that combustion supplies a meaningful amount of heat toward raising the combustion byproducts to raceway temperatures. If a hydrocarbon injectant did not supply heat, a blast furnace operator would have to take steps to supply that heat from another source, such as increasing both the amount of coke and the amount of the oxygen to stimulate the burning of that additional coke. As Dr. Wakelin notes, that is precisely why hydrocarbon injectants are more cost-effective than steam.

The only significant argument that Carbon Injection Systems presents in opposition to this conclusion is the claim that a substantial portion of hydrocarbon injectants is not, in fact, combusted in the raceway. To support this claim, Carbon Injection Systems relies on the testimony of Mr. Rorick, an experienced blast furnace operator and consultant. In theory, the extent to which injectants combust is relevant to the substantial, useful heat question because if Mr. Rorick could have established that only a minimal amount of injectants were combusted in the WCI Steel blast furnace, this information could undercut EPA's claim that the combustion of hydrocarbon injectants plays an important role in raising the temperature of injectant-contributed reducing gases.

Mr. Rorick relied upon his experience in operating blast furnaces and his knowledge in how they work to present a credible position that some injectants are not combusted in the raceway. ALJ Tr. at 2417-21 (testimony of Mr. Rorick) (explaining that in doing repair work on furnaces he, as well as other furnace operators, found unreacted injectants outside of the raceway). Mr. Rorick was less persuasive, however, in his attempt to provide any defensible estimate of the amount of injectants that escape the raceway without combusting.

Mr. Rorick explained that injectants are only in the raceway for a very short time due to the high velocity of the hot blast:

> The injectants come out [of the lance in the tuyere] faster than 750 feet per second and they come out at a greater pressure than the * * * pressure of the hot blast.
>
> * * *
>
> [T]he first thing that happens is any moisture that's in that hydrocarbon is evaporated.

> * * *
>
> The second thing that happens is if there [are] any volatiles in that hydrocarbon, they're immediately separated.
>
> * * *
>
> [A]nd then what's left we'll try to react with the oxygen that's in the hot blast in this high temperature zone but as I circled [on the demonstrative exhibit], I've only got three one-thousandths to five one-thousandths of a second for this to happen.

Id. at 2397-98. Due to the limited time that injectants spend in the raceway, Mr. Rorick asserted that not all injectants are combusted. According to Mr. Rorick, the amount combusted depends on how much injectant is used and how effectively the furnace is operated. *Id*. at 2413.

However, Mr. Rorick was not particularly precise as to how much injectant may pass through the raceway without combusting. He testified that:

> [I]t can be as much as 70 percent [of the injectant] exits [the raceway] as char [i.e., unreacted carbon] and it can be as little as 10 or 15 percent exits as char and if you really go super low injectant down to 20, 30 pounds [of injectant] per ton [of iron produced], maybe that small amount, maybe it's none.

Id. at 2413. The fluidity of these figures is further illustrated by the fact that Mr. Rorick used a different maximum value in a Report he prepared for the proceedings before the ALJ. *Technical Report on Blast Furnace Issues*, RX 108 *at* CIS02022. There, he stated: "More than 50%, and up to 60% of the injected hydrocarbon carriers are found to actually react outside the raceway zone." *Id*. at CIS02025. Mr. Rorick also did not provide a figure for the amount of injectants that were not combusted at the WCI Steel blast furnace. He implied that the amount of injectant not combusted at the WCI furnace may have been closer to the higher end of the range, because WCI's injection rate was somewhat above the theoretical maximum amount of injectant that could be combusted in the raceway, WCI's stoves produced a hot blast at a relatively low temperature compared to the industry standard, and

the lances WCI Steel used to inject the hydrocarbons did not finely disperse or "atomize" the injectant.[51] ALJ Tr. at 2496-98.

More problematically, in neither his testimony nor his declaration did Mr. Rorick provide anything more than the barest of explanations for how he arrived at his estimate of the level of injectants leaving the raceway unreacted. He appeared to base his estimate on the assumption that the maximum amount of a hydrocarbon injectant that can be combusted in the raceway is "about 80 pounds per ton [of iron produced]." *Id*. at 2412-2413. But Mr. Rorick's view on the accuracy of this figure can be described as conflicted, at best. He both attributed the figure to "academics" following "false doctrine" and also claimed he has "no reason" to believe that the calculation is "wrong." *Id*. at 2411-12 (testimony of Mr. Rorick); *Technical Report on Blast Furnace Issues*, RX 108 *at* CIS02025 (describing the combustion theory of blast furnaces as "false doctrine"). In his testimony, Mr. Rorick explained the derivation of the 80 pounds per ton of iron produced ["lbs/ton"] figure as follows:

> Now, no one can tell exactly how much [injectant] goes one place.
>
> What I can tell you is this: In terms of injectants, because of the previous combustion theory where everything had to be combusted in the raceway, there were technical calculations done in Japan in the 1960s and early '70s that said the maximum amount of injectant that you could put in the blast furnace is the maximum amount that can be reacted in the raceway and that number is about 80 pounds per ton [of iron produced]. * * *
>
> What happened was, and they built a whole industry based on that 80 pounds per ton. That's how much the capacity of the equipment they installed.

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[51] Dr. Fruehan contested Mr. Rorick's conclusion on the amount of liquid hydrocarbon injectants combusted in the raceway. He agreed that for solid hydrocarbons, such as pulverized coal, a substantial amount may not be combusted at high injectant rates because of coal's low combustion rate. ALJ Tr. at 1137-38. The situation is significantly different for liquid and gaseous hydrocarbons, Dr. Fruehan argued, due to their higher combustion rates. *Id*. Submissions by Carbon Injection Systems confirm that coal is harder to combust than either liquid or gaseous hydrocarbons. Joseph J. Poveromo, *Blast Furnace Fuel Injection Trends* (Oct. 2004), RX 97 at CIS01629.

> Meanwhile at another place some operators were having a problem with their coke ovens and so they didn't have enough reductant so they decided, all right, let's try to put some more injectant in and see what happens and they did and it worked so the 80 [lbs/ton], the theoretical barrier that the academics had calculated turns out it was only a theory, it wasn't a reality. The amount of maximum amount of injectant that can actually be put in a blast furnace these days is nearly 550 pounds per ton[52] not 80 [lbs/ton] and it can be effectively done.

ALJ Tr. at 2411-12. Despite inextricably linking the 80 lbs/ton figure to the purveyors of the "false doctrine" of the combustion theory of blast furnaces, Mr. Rorick nonetheless used that figure to calculate the amount of hydrocarbon injectant not reacted in the raceway. He stated in his testimony:

> So how much [injectant] goes each place, goes each way which was your original question depends on what level of injectant you're at and how effectively you're operating the blast furnace * * *.
>
> It can be as much as[,] *if it's 80 [lbs/ton that is the maximum that can be combusted in the raceway], if the calculations, and I have no reason to believe they're wrong*, it can be as much as 70 percent [of the injectant] exits [the raceway] as char [i.e., unreacted carbon] and it can be as little as 10 or 15 percent exits as char and if you really go super low injectant down to 20, 30 pounds per ton, maybe that small amount, maybe it's none.

ALJ Tr. at 2413 (emphasis added).

Further undercutting Mr. Rorick's reliance on the 80 lbs/ton figure to estimate the amount of injectant not reacted in the raceway are the significantly larger estimates that Carbon Injection Systems experts added to the record in this case. In a declaration filed in the record, Mr. Rorick himself stated that the "theoretical limit" for the amount of injectant that can be combusted in a blast

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[52] Mr. Rorick may have misspoken, or been mis-transcribed, here in that later he repeatedly stated that the maximum amount of injectant commonly used is 200 pounds per ton. ALJ Tr. at 2441, 2483. For comparison, WCI Steel used between 100 and 120 pounds of liquid hydrocarbon injectants per ton of iron produced. *Id.* at 2498 (testimony of Mr. Rorick).

furnace "was established at 50-60 kg/ton of hot metal." Declaration of Frederick Charles Rorick (Apr. 2, 2012), RX 103 at CIS02007. Presuming the units here are kilograms per metric ton, converting 50-60 kg/ton to equivalent units of the 80 lbs/ton figure yields a value of 100-120 lbs/ton.

Information provided by Dr. Poveromo gives an even larger figure. In an article that he authored and attached to his declaration, he stated: "up to the mid-1980's most coal injection systems were designed to inject at moderate enough rates (75-150 kg/T [kilogram/metric ton]) to ensure that theoretical coal combustion would occur in the blast furnace raceway." Joseph J. Poveromo, *Blast Furnace Fuel Injection Trends* (Oct. 2004), RX 97 at CIS01623. These values convert to 150-300 lbs/ton. Dr. Poveromo's use of a coal-specific figure is important because injectants have different combustion rates with coal being the least combustible, natural gas being the most, and oil falling between the two. *Id*. at CIS01629; *accord* ALJ Tr. at 1156 (testimony of Dr. Fruehan). Mr. Rorick did not disclose what type of hydrocarbon injectant was used in calculating his theoretical maximum combustion figure of 80 lb/ton.[53]

In the end, we conclude that Mr. Rorick did not establish that only a minimal amount of injectants are combusted in the raceways of blast furnaces generally or in the WCI Steel blast furnace specifically. While he presented credible evidence based on his personal practical experience and anecdotal incidents that some injectants are not combusted in the raceway, his information concerning the level

[53] Mr. Rorick does say that the figure was calculated in Japan and industrial furnaces were then constructed on the basis of that figure. Dr. Poveromo's article states that "Japan moved aggressively to implement [pulverized coal injectants] starting in the early 1980's." Joseph J. Poveromo, *Blast Furnace Fuel Injection Trends* (Oct. 2004), RX 97 at CIS01619.

of injectant that passes through a blast furnace raceway without combusting is so vague and unsubstantiated that we conclude it is unreliable. [54]

In addition, the reasons the ALJ cited in the Initial Decision for questioning the "soundness" of the Administrator's determination that hydrocarbon injectants provide substantial, useful heat are unpersuasive. Init. Dec. at 73. First, the ALJ cited Dr. Fruehan's assertion that the combustion of injectants is exothermic, and the Region's "concession" that blast furnaces rely on chemical energy, as "cast[ing] doubt" on the "reliability" and "thoroughness" of EPA's technical determinations in the *1985 Burning of Waste Fuel Rule*. *Id*. at 72-73. Even assuming that Dr. Fruehan's testimony and the Region's "concession" are inconsistent with the Administrator's Cadence determination, they do not undermine the Administrator's decision. At most, Dr. Fruehan's testimony and the Region's chemical energy argument suggest that the Administrator understated the heat energy, and overall energy, hydrocarbon injectants provide to a blast furnace. Accordingly, they do not supply a ground for concluding that the Administrator was *incorrect* to classify hydrocarbon injectants as providing substantial, useful heat.

More importantly, however, the ALJ erred in concluding that Dr. Fruehan's testimony and the Region's chemical energy argument are in conflict with the Administrator's decision. As discussed in Section V.E.2., it is not at all clear that when EPA described the "net" reaction of injectants as being endothermic, it meant the reaction itself, rather than the effect of the use of injectants and coke more generally given the endothermic nature of the reduction reactions in the furnace. *See* 50 Fed. Reg. at 49,173. Further, the Region's legal argument that the phrase "burned to recover energy" should be interpreted as including chemical energy does not suggest that the Administrator did not understand that injectants are involved in the chemical reactions in a blast furnace. In fact, the Region's legal argument to the ALJ for including chemical energy cited to the Administrator's discussion of injectants' "dual purpose of providing substantial needed energy [i.e., heat] and

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[54] Even assuming that Mr. Rorick is correct that only 30 % of the injectant at the WCI Steel furnace was combusted in the raceway – the smallest figure mentioned by Mr. Rorick in the context of any blast furnace – that amount of injectant combusted appears substantial rather than minimal. *See* ALJ Tr. at 2498 (testimony of Mr. Rorick). For example, 30 % of the roughly 120 pounds of hydrocarbon material with a heat value of 18,000 BTUs/lb being injected for every ton of iron produced yields 40 pounds of injectants with a heat value of 18,000 BTUs/lb being combusted. Hence, even overlooking the manifest problems with Mr. Rorick's estimate of the amount of injectants that are combusted, this argument by Carbon Injection Systems is still unpersuasive.

reductants.'" Complainant's Post-[ALJ] Hrg. Reply Brief at 25 (quoting 50 Fed. Reg. at 49,173).

As a second ground for rejecting the Cadence determination on whether hydrocarbon injectants provide substantial, useful heat, the ALJ referred to "advances in the understanding of the *operation* of a blast furnace." Init. Dec. at 83 (emphasis added). Here, the ALJ relied on the testimony of Mr. Rorick who testified that there had been dramatic changes in the understanding of blast furnaces in the last 30 years. ALJ Tr. at 2367-69. The ALJ specifically referenced Mr. Rorick's discussion of the amount of injectants combusted in the raceway and his assertion that EPA and Dr. Fruehan relied upon an outdated "combustion" theory of blast furnace operation. Init. Dec. at 70, 75; *see* ALJ Tr. at 2366-69 (testimony of Mr. Rorick). But regardless of whether the understanding and operations of blast furnaces have changed, there is nothing in the record before us, including the testimonies of the various experts, that suggests that carbon-based materials are not combusted in the raceway or that those reactions have changed.[55] Rather, all three experts testified that some or all of hydrocarbon injectants will combust with oxygen in the raceway to produce reducing gases. ALJ Tr. at 1092 (testimony of Dr. Fruehan), 2544-45 (testimony of Dr. Poveromo), 2398 (testimony of Mr. Rorick); *see Characteristics of the Blast Furnace*, CX 13 at EPA-10114.

We explained above why Mr. Rorick's testimony on the amount of injectants combusted is unpersuasive on the substantial, useful heat question. Mr. Rorick's attempt to tie the "combustion" theory of furnaces to Dr. Fruehan and the Administrator's preamble determinations in the *1985 Burning of Waste Fuel Rule* is equally unconvincing. Dr. Fruehan vigorously disputed Mr. Rorick's testimony on this point, ALJ Tr. at 1132, and, in fact, the main thrust of Dr. Fruehan's testimony was directed precisely at explaining the dominant role of chemical energy in a blast furnace. *Id*. at 1097-1108. For its part, EPA, in the *1985 Burning of Waste Fuel Rule*, repeatedly emphasizes the chemical energy involved in blast furnaces. Thus, Mr. Rorick's testimony concerning the outdated "combustion" theory of blast furnaces is ineffectual in discrediting the Administrator's Cadence determination.

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[55] Babcock and Wilcox's description of the combustion of carbon and the dissociation of this combustion's byproducts has not changed as of the 41st edition of Steam: Its Generation and Use, which was released in 2005. Babcock & Wilcox Co., *Steam: Its Generation and Use* 10-7 – 10-11 (41st ed. 2005).

The ALJ also cited to Mr. Rorick's extended discussion of the advances made in blast furnace technology and operation, implying that these advances themselves undermine the EPA preamble in the *1985 Burning of Waste Fuel Rule*. The ALJ summarized Mr. Rorick's testimony on these advances as follows:

> Mr. Rorick explained that these dissections [of blast furnaces performed in the 1970's and 1980's] revealed that the interior of a blast furnace is split into distinct zones where critical steps in the production of the liquid iron occur, a discovery that enabled "massive increases in blast furnace size, productivity and efficiency," "a great expansion of reductant injection technology in both variety of injectants that were used and quantity used per ton of hot metal," and the "develop[ment] [of] instruments and probes to start quantifying what was actually going on inside the process because now we knew where to look."

Init. Dec. at 75 n.36 (quoting testimony of Mr. Rorick). We fail to see, however, how such generalities pertain to the issue in this case. Mr. Rorick seemed to be contending that some portion of hydrocarbon injectants were reacted in parts of the furnace outside of the raceway in non-heat producing reactions. ALJ Tr. at 2483; *Technical Report on Blast Furnace Issues*, RX 108 at CIS 02025. But Mr. Rorick's testimony on the amount of hydrocarbon injectants not combusted in the raceway is unreliable. Neither the ALJ nor Carbon Injection Systems provided any other explanation of why a better understanding of where critical steps in blast furnace operations occur shows that injecting a high BTUs/lb value hydrocarbon into a blast furnace does not produce substantial, useful heat. On the other hand, Dr. Fruehan testified that EPA's discussion in the *1985 Burning of Waste Fuel Rule* of how a blast furnace operates was "reasonably accurate." ALJ Tr. at 1129-30, 1174.

For all of these reasons, we hold that Carbon Injection Systems has not provided any ground to reconsider the Administrator's Cadence determination and the ALJ erred in finding otherwise.

c. *The Board Concludes that Carbon Injection Systems' Hydrocarbon Injectants Provided Substantial, Useful Heat When Combusted in the WCI Steel Blast Furnace*

We conclude that the evidence in the record and the sources relied upon by the parties show that Carbon Injection Systems' use of hydrocarbon injectants in

the WCI Steel furnace supplied substantial and useful heat.[56] Contrary to the conclusion of the ALJ, we find that there was no significant conflict between the scientific expert witnesses on the heat energy question other than Mr. Rorick's claim regarding the amount of injectants that are combusted in the raceway. Dr. Fruehan testified that injectants provide heat that at least partially heats up injectants' combustion byproducts. Dr. Poveromo did not contest these conclusions in his testimony and his declaration provides important evidence confirming them.[57] And we reject Mr. Rorick's testimony on the amount of injectants that are not combusted as inconsistent, non-specific, and unsubstantiated.

Drs. Fruehan and Poveromo certainly did differ on what the scientific evidence showed on the central legal question in the case – did the injectants supply substantial, useful heat energy. Dr. Fruehan focused on the large amount of energy supplied by injectants, and argued that this fulfilled the substantial, useful heat standard. On the other hand, Dr. Poveromo advocated for use of a "net" heat balance approach, and concluded that because the overall "net" effect on temperature of the raceway from use of injectants was negative, any heat from injectants could not be substantial and useful. But whether the scientific evidence meets the relevant legal standard is a question to be resolved by the judicial decisionmaker, not expert fact witnesses.

We reject the use of a net heat energy approach as an outcome determinative test for deciding whether hydrocarbon injectants provide substantial, useful heat. Neither Carbon Injection Systems nor the ALJ offered any reason why the Administrator's prior rejection of such a net heat approach should be disregarded. Further, we conclude that a net heat approach is inconsistent with the intended purpose of the substantial, useful heat standard, if not its plain meaning. The substantial, useful heat standard was designed to distinguish significant or purposeful uses of fuels from the use of low energy fuels that provide only incidental heat energy. A net heat approach, however, by widening the lens of observation, directs attention away from the fuel in question to such external factors

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[56] In finding that the hydrocarbon injectants here – like the hydrocarbon injectants considered in the Cadence determination – provide "substantial, useful heat," we do not suggest that the phrase is limited to these specific circumstances.

[57] Because our de novo review concludes that Dr. Fruehan did not differ with Dr. Poveromo on the basic scientific facts of blast furnace reactions, we disagree with the ALJ's conclusion that Dr. Poveromo's position compared to Dr. Fruehan's was "simply * * * more clear and comports with common sense." Init. Dec. at 70.

as the heat contributed by the fuel being replaced and the temperature of the combustion environment (here, the raceway). More than anything else, such an approach obscures the amount of heat provided by the replacement fuel and is likely to produce arbitrary determinations. As this case shows, under a net heat approach, one would get a different answer to the question of do "fuel oil" injectants provide substantial, useful heat if the injectants are serving as a replacement for steam or natural gas as opposed to coke.

Conversely, when we apply the substantial, useful heat standard in the way the EPA Administrator intended – to exclude low energy fuels that only provide incidental heat from the phrase "burned to recover energy" – the record evidence from Drs. Fruehan, Poveromo, and Wakelin clearly shows that the heat energy derived from the 18,000 – 20,000 BTUs/lb hydrocarbon liquid injectants Carbon Injection Systems supplied to WIC Steel was not incidental, but instead played a significant and purposeful role in supplying the heat energy needed to raise the injectants' combustion byproducts at least part of the way up to the raceway temperature.

For all of these reasons, we hold that the ALJ erred in not following the substantial, useful heat standard in the manner it was articulated in the preamble to *1985 Burning of Waste Fuel Rule.* Moreover, we further find that the evidence in this case does not merely fail to overcome the substantial weight accorded authoritative decisions of the Administrator; rather, that evidence reaffirms the soundness of the Administrator's determination in the preamble to the *1985 Burning of Waste Fuel Rule* that hydrocarbon materials with substantial heating value provide substantial, useful heat when injected into an iron blast furnace. The evidence presented by Drs. Fruehan, Poveromo, and Wakelin, among other things, clarifies that combusting liquid hydrocarbon injectants in the raceway contributes an important heat component to the blast furnace. Although replacing coke with hydrocarbon injectants cools the blast furnace raceway, due primarily to the huge temperature differential between hydrocarbon materials injected "cold" and preheated coke, this fact does not mean that the heat contributed by hydrocarbon injectants is non-existent or inconsequential. If a blast furnace operator uses an injectant with little or no heating value instead of a hydrocarbon injectant, the operator would have to take measures such as burning more coke to substitute for the lost heat supplied by the hydrocarbon injectant. This is precisely why hydrocarbon injectants are a "cost-effective" substitute for coke compared to non-heat producing injectants such as steam: hydrocarbon injectants can replace coke's role in providing reducing gases and at least a substantial part of coke's role in supplying heat to the furnace.

5. *Substantial, Useful Heat and the Use of the Top Gas; the Proffer of Extra-record Material*

In its briefs on *sua sponte* review before the Board, the Region argues that hydrocarbon injectants supply substantial, useful heat because they contribute carbon monoxide to a furnace's top gas and the top gas' carbon monoxide is captured and burned in the furnace's stoves to heat the hot blast. As support for this argument, the Region cites to the testimony of each of the expert witnesses asserting that the top gas is a valuable commodity, and use of it for its heating value is a common, if not universal, practice. Region 5's Opening Brf. at 29-30; *see How a Blast Furnace Works*, CX 86 at EPA-18464, EPA-18467. In addition to the common industry practice evidence, the Region cites a study that describes how the prior owner of the WCI Steel furnace used the furnace's top gas ("Prior Owner study"). Region 5's Opening Brf. at 29 n.5. Although the Prior Owner study was not cited nor otherwise identified in the proceeding before the ALJ, the Region argues that the Board can take official notice of the study because it is present in a 1987 RCRA rulemaking docket. *Id*. The Region admits it introduced no direct evidence in the proceeding before the ALJ concerning capture and use of the top gas at the WCI Steel blast furnace. However, the Region claims that the testimony from the expert witnesses and Prior Owner study met its burden of going forward on its prima facie case regarding the use of the top gas at the WCI Steel furnace and shifted the burden to Carbon Injection Systems to respond. Region 5's Resp. Brf. at 8.

The ALJ rejected the Region's argument in the Initial Decision citing the lack of any direct evidence and the Region's seemingly contradictory argument that the penalty level for Carbon Injection Systems should be increased due to the environmental risk caused by direct venting of the top gas to the atmosphere. Init. Dec. at 87. The Board did not designate this determination by the ALJ as an issue for *sua sponte* review. To the contrary, the Board's order delineating the issues to be briefed for review expressly confined the substantial, useful heat question to heat generated within the raceway.

> Did the hydrocarbon materials distributed by Carbon Injection Systems to WCI Steel, Inc., supply substantial, useful heat energy *upon combustion in the raceway* of WCI Steel's iron blast furnace? Specifically, the Board requests that you address the ALJ's determination that the hydrocarbon materials supplied by Carbon Injection Systems did not contribute substantial, useful energy to the WCI Steel iron blast furnace "because of their net consumption of energy and consequential cooling effect *in the raceway*."

Issues to be Briefed at 2 (quoting Init. Dec. at 83). In fact, the language quoted from the Initial Decision comes from the section of the decision addressing whether substantial, useful heat is produced from combustion of injectants in the raceway and not from the separate section addressing the substantial, useful heat question in the context of use of the top gas. *See* Init. Dec. at 83.

Carbon Injection Systems raises several objections to the Region's claim: (1) neither the expert testimony nor the Prior Owner study show what Region 5 contends; (2) the Prior Owner study is not in the record and the Board may not take official notice of the study; and (3) the top gas issue exceeds the scope of issues for *sua sponte* review as detailed in the Board's order. CIS' Resp. Brf. at 12-13; Respondents Carbon Injection Systems LLC, Scott Forster and Eric Lofquist's Motion to Strike at 3-4. We find Carbon Injection Systems' argument that "the Region exceeded the scope of the Board's sua sponte review" to be determinative. The Board did not request briefing on the top gas question and Carbon Injection Systems' noting that the Region had failed to carry its burden of proof on this point did not open the door to re-litigating that issue. The Board's order certainly did not put Carbon Injection Systems on notice that it needed to brief the top gas issue. Thus, were we to reach this issue, Carbon Injection Systems would be unfairly disadvantaged because the Region essentially has had a greater opportunity to make its arguments concerning the heat potential in the top gas to the Board. We could address that concern by allowing yet more briefing in this case, but our initial judgment was that the ALJ's ruling on the top gas question was fact-specific to the Region's proof in this particular case, and thus did not raise the programmatic concerns involved with the other issues.[58] Nothing in the parties' briefs has

[58] As noted in note 26 *supra*, the decision not to take this issue for *sua sponte* review should not be interpreted as implying that the furnace's top gas is unimportant generally in assessing whether hydrocarbon injectants are burned for energy recovery. To the contrary, in addressing whether a material is being burned for energy recovery because it provides substantial, useful heat, energy contributed in any part of the entire system should be taken into account. Moreover, there is nothing in the regulations, its preamble, or EPA's Cadence determination that suggests or requires that the substantial, useful heat so generated be used within the raceway or other parts of the blast furnace itself. Some of the material may be used to heat the iron ore that is descending into the raceway, with the remaining material exiting the furnace in the top gases and then being used elsewhere in the blast furnace operations (e.g., to preheat the coke) or in the steel plant itself. The EPA Administrator acknowledged as much in the preamble to the *1985 Burning of Waste Fuel Rule* when he stated:

convinced us otherwise. Accordingly, we decline to entertain the Region's arguments on whether the use of top gas at the WCI Steel furnace provided substantial, useful heat.

VI. *CONCLUSION*

If this were a routine appeal by the Region of an ALJ dismissal of an enforcement case, our determination that the ALJ erred in holding that none of the hazardous materials in this case come within RCRA jurisdiction generally would result in the Board remanding the case to the ALJ to resolve any remaining issues in the case and a determination, if appropriate, of a penalty. But this is anything but a routine appeal. Based on the three factors discussed below, we have decided that despite our decision to vacate the Initial Decision, we are nonetheless dismissing the case, but on grounds other than those relied on by the ALJ. None of the three factors on their own would necessarily warrant dismissal of this action. Nonetheless, we conclude that these factors, when weighed together, support the Board's decision.

The first factor is that it was the Board who chose to review this case. The losing party below, the Region, chose not to appeal the ALJ's decision. The Board exercised *sua sponte* review because we were concerned both about the substance of the ALJ's judgments on the scope of the RCRA program and her decision not to accept or give appropriate weight to the EPA Administrator's prior resolution of the central issue in this case. Through this opinion we have addressed both the substantive RCRA legal issues as well as the precedential status of EPA Administrator decisions that govern ALJ adjudications and Board review. Remanding this case will not further clarify these issues.

> The heat energy released from subsequent (i.e., outside the combustion zone) reactions of fuel injectant hydrocarbons is in fact substantial, intentional, and useful contrary to Cadence' s claim that it is incidental and unavoidable. As discussed above, *furnace top gas is used as fuel in stoves to heat the hot blast, in a boiler plant, or in other heating applications within the steel plant*. The excess reducing gas contained in the top gas that was not used to reduce the iron ore gives the top gas substantial heating value.

50 Fed. Reg. at 49,172-73 (emphasis added).

The second factor relates to the manner in which the Region has prosecuted this case before the Board. Today's decision reverses the ALJ's determination that Carbon Injection Systems' injectants were not burned for energy recovery and thus were not wastes under the RCRA provisions of the Ohio Administrative Code. We conclude that the combustion of those injectants in the WCI Steel blast furnace's raceway were burned for energy recovery because they did provide substantial, useful heat. We reached that conclusion despite the Region's repeated concession in its pleadings and oral argument before the Board that the combustion of injectants in a blast furnace raceway does not provide substantial, useful heat, and its belated adoption of the net heat approach advanced by Carbon Injection Systems and adopted by the ALJ.[59] Region 5's Opening Brf. at 29 (stating that "[w]ith respect to 'heat energy' 'upon combustion in the raceway,' the answer is no, the CIS materials did not provide substantial, useable heat energy in the raceway.") Region 5's Resp. Brf. at 1 (noting that "the secondary material injectants do not add immediate heat value to the furnace raceway upon injection"), 3 (stating that "EPA has never claimed that the initial combustion of a hydrocarbon injectant is exothermic in the raceway"); EAB Tr. at 28, 133; Region 5's Post-Arg. Brf. at 2 (arguing that the terms "substantial," "useful," and "sensible" in the *1985 Burning of Waste Fuel Rule* indicated that a net impact approach is appropriate). Admittedly, this case involves complex scientific questions. Still, the Board is charged with being an independent decisionmaker in resolving administrative penalty adjudications and other disputes between EPA and regulated parties or members of the public. The Board is not part of the Agency's enforcement arm. Rather, one of the reasons the Board was established was to clarify that the Administrator's enforcement authority is "separate and distinct" from the Administrator's adjudicatory authority. *See* 57 Fed. Reg. at 5321. While we do have a responsibility to ensure that EPA's regulations are construed and applied properly, it would be inappropriate for us to revive a dismissed action against regulated parties when the Agency's prosecuting arm has conceded the most critical

[59] The Region steps back slightly from this concession in its post-argument brief. There, the Region states that "it is possible to read the Cadence discussion as concluding that the oxidation of hydrocarbon injectants in the combustion zone provides substantial, useful heat in the combustion zone." Region 5's Post-Arg. Brf. at 3. At the same time, the Region argues in favor of using a "net" heat impact approach in applying the substantial, useful heat standard and states that "the net impact of the hydrocarbon injectant on flame temperature [in the combustion zone] is to lower that temperature." *Id*. at 2-3.

aspect of the case. This factor weighs heavily in the Board's decision not to remand the case.

Finally, we cannot help but note that this case is almost five years old already, and we are not persuaded that the remaining issues could be resolved quickly if we were to remand the matter. While we do not think this time period is extraordinary, the time this case has been pending does carry some weight. Further, this dispute between the Region and Carbon Injection Systems dates back to at least 2005 when associates of Carbon Injection Systems sought an opinion from the Region concerning the use of hazardous waste as blast furnace injectant.

Accordingly, taking into account all of these factors, but particularly the Region's concession of the critical issue on appeal coupled with its adoption of the incorrect standard, we are taking the relatively atypical – but appropriate – step of not remanding the action, and instead vacating the Initial Decision and dismissing on other grounds.

So ordered.