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APPLYING THE PENNSYLVANIA ENVIRONMENTAL RIGHTS AMENDMENT MEANINGFULLY TO CLIMATE DISRUPTION

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ABSTRACT

The Pennsylvania Constitution contains a unique Environmental Rights Amendment (ERA), which recognizes an individual right to "clean air, pure water, and to the preservation of the natural, scenic, historic and esthetic values of the environment." The ERA also includes a public trust element that makes "Pennsylvania's public natural resources . . . the common property of all the people, including generations yet to come." It makes the Commonwealth the "trustee of these resources," requiring it to "conserve and maintain them for the benefit of all the people." Recent decisions by the Pennsylvania Supreme Court (the Court) in Robinson Township v. Commonwealth *and* Pennsylvania Environmental Defense Foundation v. Commonwealth *provide significant support for Pennsylvania regulations to address the threat of climate disruption posed by greenhouse gas (GHG) emissions to achieve net zero carbon emissions by the middle of this century.*

In light of the threats that climate disruption poses to Pennsylvania's public natural resources, the text of the ERA, and the principles articulated in those recent cases, we argue that a stable climate (a climate that has not been disrupted by anthropogenic emissions of GHGs) should be considered protected by the rights recognized by the ERA, and the public trust duties it creates. We argue that these rights and duties require Pennsylvania to employ regulatory measures to reduce GHG emissions to the level warranted by the social cost of carbon and to achieve carbon neutrality (net zero emissions) by mid-century. Further, we argue that there are judicially recognizable standards to compel the Commonwealth to exercise its existing authority to limit GHG emissions. In light of existing legislative authority, the obligations imposed by the United Nations Framework Convention on Climate Change, the Paris Agreement, and the federal Clean Air Act, we make the case that this regulatory program should take the form of an economy-wide cap-and-trade program providing for the auction of allowances with a reserve price based on the social cost of carbon and additional measures to prevent leakage and a cap reaching carbon neutrality by mid-century.

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TABLE OF CONTENTS

INTRODUCTION

In 1971, Pennsylvania voters overwhelmingly approved a nationally unique Environmental Rights Amendment (ERA) to the Pennsylvania Constitution, creating an individual right for all Pennsylvanians to "clean air, pure water, and to the preservation of the natural, scenic, historic and esthetic values of the environment."[1] The ERA further made "Pennsylvania's public natural resources . . . the common property of all the people, including generations yet to come,"[2] and made the Commonwealth the "trustee of these resources,"[3] requiring it to "conserve and maintain them for the benefit of all the people."[4] Despite the ERA's strong and clear language, for nearly half a century Pennsylvania courts left the provision toothless, substituting a three-part balancing test for the text of the ERA—a test completely divorced from the text that required little more than compliance with existing laws, and under which environmental advocates almost never won.[5] In *Robinson Township v. Commonwealth* (*Robinson Township*) and *Pennsylvania Environmental Defense Foundation v. Commonwealth* (*PEDF*), the Court dramatically reversed this approach, for the first time striking down acts of the General Assembly that it found to violate the ERA.[6] In the *PEDF* case, the Court expressly rejected

1. PA. CONST. art. I, § 27.

2. *Id.*

3. *Id.*

4. *Id.*

5. *See infra* note 24 and accompanying text; Payne v. Kassab, 312 A.2d 86, 94 (Pa. Commw. Ct. 1973), *aff'd* 361 A.2d 263 (Pa. 1976).

The test bore no significant relationship to the text of Section 27. John C. Dernbach, *Taking the Pennsylvania Constitution Seriously When It Protects the Environment: Part II: Environmental Rights and Public Trust*, 104 DICK. L. REV. 97, 136-42 (1999). *See* John C. Dernbach & Marc Prokopchak, *Recognition of Environmental Rights for Pennsylvania Citizens: A Tribute to Chief Justice Castille*, 53 DUQ. L. REV. 335, 338-51 (2015); *see infra* discussion note 25.

6. *See* Robinson Twp. v. Commonwealth, 83 A.3d 901, 969 (Pa. 2013) (plurality); Pa. Envtl. Def. Found. v. Commonwealth, 161 A.3d 911, 930-36 (Pa. 2017).

the three-part balancing test, and held that the text of the ERA itself should be the primary basis for interpreting and applying it.[7] These decisions also confirmed that the ERA created enforceable individual rights to environmental protection and that the Commonwealth had a judicially enforceable duty as a trustee to protect those rights and to conserve the corpus of the environmental trust.[8]

The *PEDF* decision, in particular, provides significant support for meaningfully pricing GHG emissions based on the social costs of GHG-caused climate disruption. In *PEDF*, the Court held that the Commonwealth's duty as a trustee under Article I, § 27 of the Pennsylvania Constitution governs the disposition of natural gas lease revenues from state forest and park lands. It therefore struck down acts of the General Assembly that it found inconsistent with that duty. That legislation transferred monies received from gas leasing of state lands—which the Court held to represent "capital" or the corpus of the constitutional trust—into the General Fund, where it could be spent for purposes other than the conservation and maintenance of public natural resources.

Because climate disruption poses an existential threat to all of Pennsylvania's environmental trust resources, the logic of the *PEDF* decision leads to the conclusion that the ERA creates a duty for the Commonwealth to address climate disruption caused by GHG emissions. That conclusion, coupled with existing legislative authority, supports arguments for putting a meaningful price on those emissions, commensurate with the social cost of carbon. The *PEDF* decision also calls into question the General Assembly's ability to block regulations implementing programs for the protection of trust resources, including regulations addressing climate disruption.[9] The decision's implications regarding use of revenues from allowances or fees on GHG emissions are less clear. The better arguments would allow all or substantial portions of the revenues to be used for the General Fund, as long as the revenues derive from actions that preserve, rather than deplete, the corpus of the trust.

Furthermore, the *PEDF* decision and its application to climate disruption will likely have consequences beyond Pennsylvania's borders because it provides a judicially manageable approach to implementing an environmental constitutional amendment. Although more than a third of all state constitutions include provisions regarding resource conservation and pollution, the provisions have tended to be more symbolic than legally meaningful, in no small part because courts have been unwilling or unable to find a way to enforce them.[10] Moreover, many states apply a public trust doctrine similar to the standard incorporated into the Pennsyl-

7. *See generally PEDF*, 161 A.3d 911 at 930-36.

8. *See Robinson Twp.*, 83 A.3d at 969; *PEDF*, 161 A.3d 911 at 930-36.

9. *See PEDF*, 161 A.3d at 934-40.

10. Barton Thompson, *Constitutionalizing the Environment: The History and Future of Montana's Environmental Provisions*, 64 MONT. L. REV. 157, 158-9 (2003).

vania ERA,[11] and a great many countries have environmental rights provisions in their constitutions.[12] Because *PEDF* enforces an environmental rights provision and provides a judicially manageable standard for doing so, the decision will likely be influential in the many other states and countries with comparable provisions.[13]

PEDF also can impact efforts elsewhere to use the public trust doctrine and environmental constitutional provisions to compel governments to reduce GHG pollution and prevent climate disruption. Some countries expressly address climate change in their constitutions, and a growing number of courts have found a right to climate justice in other provisions of their constitutions.[14] Examples include both the Netherlands[15] and at least one federal district court in the United States.[16] In light of the hostility of the current U.S. administration to the issue of climate change, actions by the states to limit GHG emissions and to address the problem of climate disruption have become particularly significant. We argue that the analysis in *PEDF* matters for the states with constitutional environmental protection provisions or public trust obligations by showing how a constitutional environmental provision can support a petition for rulemaking to limit GHG emissions in order to limit climate disruption, and also support a regulatory agency's authority to subsequently adopt and implement such a rulemaking.

Finally, *PEDF* is one in a series of cases in which the Pennsylvania Supreme Court has applied cogent historical and textual analysis to restore moribund state

11. *See* Barton Thompson, *The Public Trust Doctrine: A Conservative Reconstruction and Defense*, 15 SE. ENVTL. L.J. 47, 50-55 (2006).

12. JAMES R. MAY & ERIN DALY, GLOBAL ENVIRONMENTAL CONSTITUTIONALISM (2015).

13. *See* John C. Dernbach, Kenneth T. Kristl, & James R. May, Pennsylvania Environmental Defense Foundation v. Commonwealth of Pennsylvania: *Recognition of Environmental Rights for Pennsylvania Citizens*, RUTGERS L. REV. (forthcoming 2018) (manuscript at 39), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3137074 (arguing that PEDF is a "formative case[]" which is likely to "shape shared conversation in the legal academy and elsewhere for generations to come").

14. *Id.* at 39.

15. *See* Rechtbank Den Haag [Hague Court] 24 juni 2015, HA ZA 2015, 13-1396 m.nt. (Urgenda/State of the Netherlands) (Neth.) at 4.52 (holding that "a legal obligation of the State towards [Plaintiff] cannot be derived from Article 21 of the Dutch Constitution, . . . [but] these regulations still hold meaning, namely in the question . . . [of] whether the State has failed to meet its duty of care towards [Plaintiff]."); Robert B. McKinstry Jr., *Potential Implications for the United States of the* Urgenda Foundation v. Netherlands *Decision Holding that the UNFCCC and International Decisions Required Developed Nations to Reduce Emissions by 25 percent from 1990 Levels by 2020*, CLIMATE CHANGE, SUSTAINABLE DEV., & ECOSYSTEMS COMMITTEE NEWSLETTER, July 2016, at 30, 31, https://www.americanbar.org/content/dam/aba/publications/nr_newsletters/ccsde/201607_ccsde.
authcheckdam.pdf (noting that in the same case "[u]ltimately, the court concluded that the plaintiffs' standing to sue the state upon the Dutch state's obligation to exercise 'due care' was based on Dutch constitutional law, the law of the EU, and international law.").

16. *See* Juliana v. United States, 217 F. Supp. 3d 1224, 1241 (D. Or. 2017) (denying a motion to dismiss and holding that "[a]t its heart, this lawsuit asks this Court to determine whether defendants have violated plaintiffs' constitutional rights. That question is squarely within the purview of the judiciary."), *mandamus denied sub nom., In re* United States, 884 F.3d 830 (9th Cir. 2018), No. 17-71692.

constitutional provisions to affect their original intent.[17] In that respect, the court is emerging as an intellectual leader among state high courts.

In order best to explain the implications of the *PEDF* decision for climate disruption, we first discuss Article I, § 27 of the Pennsylvania Constitution and *Robinson Township* (Section I), and then analyze how *Robinson Township* was applied and extended in *PEDF* (Section II). Section III discusses the threats that climate disruption poses to Pennsylvania's public natural resources. In light of those impacts and the principles articulated in *Robinson Township* and *PEDF*, we make the case that a stable climate (a climate that has not been disrupted by anthropogenic emissions of GHGs) should be considered protected by the rights provided by the first clause of Article I, § 27 of the Pennsylvania Constitution, and protected by the public trust duties created by the second and third clauses. We then make the case in Section IV that the Commonwealth's duty to prevent climate disruption requires it to undertake measures to limit GHG emissions to the levels warranted by the social cost of carbon and to achieve carbon neutrality (net zero GHG emissions) by mid-century. We also argue that there are judicially recognizable standards to compel the Commonwealth to exercise its existing legislative authority to do so. Section V discusses the elements of a regulatory structure that can mitigate climate disruption. We argue that this structure should take the form of an economy-wide cap-and-trade program with allowances that are auctioned with a reserve price based on the social cost of carbon, accompanied by measures to prevent emissions "leakage." Section VI addresses issues relating to the prevention of leakage, distribution of allowances and the use of proceeds of an emissions auction. Finally, in Section VII we address limitations on the General Assembly's power to block such a regulatory program.

I. THE ENVIRONMENTAL RIGHTS AMENDMENT AND *ROBINSON TOWNSHIP*

The Environmental Rights Amendment to the Pennsylvania Constitution[18] was approved in 1971 by the voters by a margin of nearly four to one.[19] It contains

17. The jurisprudence extends beyond the *Robinson Township* and *PEDF* decisions giving meaning to the original intent of Article I, § 27. In *William Penn School District v. Pennsylvania Department of Education*, 170 A.3d 414 (Pa. 2017) the Pennsylvania Supreme Court reversed a dismissal of claims and interpreted the Education Clause in Article III, § 14 of the Pennsylvania Constitution to give meaning to its guarantee of "a thorough and efficient system of public education" in light of that clause's original intent. William Penn Sch. Dist. v. Pa. Dep't of Educ., 170 A.3d 414 (Pa. 2017). In *League of Women Voters v. Commonwealth*, the Court interpreted the Free and Fair Elections Clause in Article I, § 5, of the Pennsylvania Constitution to give that clause its original meaning, invalidating the invidious practice of partisan gerrymandering. *See* League of Women Voters v. Commonwealth, 178 A.3d 737, 741 (Pa. 2018).

18. PA. CONST. art. I, § 27.

19. Franklin L. Kury, *The Environmental Amendment to the Pennsylvania Constitution: Twenty Years Later and Largely Untested*, 1 VILL. ENVTL. L.J. 123, 123 (1990).

three clauses. The first creates individual rights to environmental attributes.[20] The second creates additional rights by making Pennsylvania's public natural resources the property of all the people, including future generations.[21] The third makes the Commonwealth, and its constituent units, trustees for the environment.[22] Article I, § 27 provides:

> The people have a right to clean air, pure water, and to the preservation of the natural, scenic, historic and esthetic values of the environment. Pennsylvania's public natural resources are the common property of all the people, including generations yet to come. As trustee of these resources, the Commonwealth shall conserve and maintain them for the benefit of all the people.[23]

Shortly after the ERA was adopted, however, Pennsylvania's Commonwealth Court devised a three-part balancing test as a substitute for the text of the ERA. That test provided:

> The court's role must be to test the decision under review by a threefold standard: (1) Was there compliance with all applicable statutes and regulations relevant to the protection of the Commonwealth's public natural resources? (2) Does the record demonstrate a reasonable effort to reduce the environmental incursion to a minimum? (3) Does the environmental harm which will result from the challenged decision or action so clearly outweigh the benefits to be derived therefrom that to proceed further would be an abuse of discretion?[24]

The test bore no significant relationship to the text of Section 27, which speaks of enforceable constitutional rights and duties.[25] Over the four decades when the test

20. PA. CONST. art. I, § 27, cl. 1.

21. *Id.* cl. 2

22. *Id.* cl. 3.

23. PA. CONST. art. I, § 27.

24. Payne v. Kassab, 312 A.2d 86, 94 (Pa. Commw. Ct. 1973), *aff'd* 361 A.2d 263 (Pa. 1976).

25. Dernbach, *supra* note 5 at 136-42.

The test's requirement for compliance with applicable statutes and regulations is meaningless with regards to a constitutional provision and certainly could not apply to actions challenging a statute on constitutional grounds. Although something like the second and third prongs of the test might conceivably be applied in some fashion where a court was balancing one constitutional right, such as a private party's property right, against the constitutional right provided by the ERA in the context of a permit decision. But it is irrelevant to evaluation of the constitutionality of a statute or the government's failure to exercise its duty as a trustee to conserve and maintain trust resources.

Even in the context of a permitting decision, the test puts a heavy, and in cases, impossibly heavy burden on the party asserting its constitutional rights under the ERA to produce evidence that the resource has been impaired. In private trust law, a trustee's duty is to gather and make available to the beneficiaries complete and accurate information as to the nature and amount of the trust property. Robinson Twp. v. Commonwealth, 83 A.3d 901, 983, n.60 (Pa. 2013) (plurality); *see also In re* Rosenblum's Estate, 459 Pa. 201, 328 A.2d 158, 164-65 (1974) (citing RESTATEMENT (SECOND) OF TRUSTS § 173)

was applied, parties invoking the ERA almost never prevailed.[26] Until the *Robinson Township* decision in 2013, no court had used the ERA to hold a statute or regulation unconstitutional.[27] In that case, however, a plurality of the Court used the ERA for precisely that purpose.

The legislation challenged in *Robinson Township* addressed the regulation of natural gas resources in the Commonwealth, particularly shale gas. The legislation superseded local governments' control over land use, as well as those governments' case-by-case consideration of the impacts of gas development on the natural environment.[28] Chief Justice Castille's plurality opinion held that the legislative crea-

(right of access to trust records is essential part of beneficiary's right to complete information concerning administration of trust; right of inspection has independent source in beneficiary's property interest in trust estate); *see also* RESTATEMENT (SECOND) OF TRUSTS § 173 *cmt. c* ("[B]eneficiary is always entitled to such information as is reasonably necessary to enable him to enforce his rights under the trust or to prevent or redress a breach of trust."). This is consistent with § 83 of the RESTATEMENT (THIRD) OF TRUSTS, which states "A trustee has a duty to maintain clear, complete, and accurate books and records regarding the trust property and the administration of the trust, and, at reasonable intervals on request, to provide beneficiaries with reports or accountings."

This disparate burden also violates the rule of impartiality, favoring the developer over the rights of the parties invoking the ERA. RESTATEMENT (SECOND) OF TRUSTS § 183 ("When there are two or more beneficiaries of a trust, the trustee is under a duty to deal impartially with them"). RESTATEMENT (SECOND) OF TRUSTS § 183 (1959); *see also* RESTATEMENT (THIRD) OF TRUSTS § 79(1) (2005). This principle is illustrated in *Estate of Sewell*, where the Pennsylvania Supreme Court found that the trustee had violated its fiduciary duty by benefiting one beneficiary at the expense of another. 487 Pa. 379, 383, 409 A.2d 401, 402 (1979) (holding against the trustee where they failed to confirm the existence of an additional beneficiary while continuing to give all benefits to the known beneficiary).

26. *See* John C. Dernbach & Marc Prokopchak, *Recognition of Environmental Rights for Pennsylvania Citizens: A Tribute to Chief Justice Castille*, 53 DUQ. L. REV. 335, 344-51 (2015).

27. *See id.* (explaining that the ERA was invoked to challenge decisions by state agencies and local governments, but not identifying any cases in which the ERA was invoked to challenge the constitutionality of a statute).

28. *Robinson Twp.*, 83 A.3d at 979.

The statute's new regulatory regime permitting industrial uses as a matter of right in every type of pre-existing zoning district is incapable of conserving or maintaining the constitutionally-protected aspects of the public environment and of a certain quality of life. In Pennsylvania, terrain and natural conditions frequently differ throughout a municipality, and from municipality to municipality. As a result, the impact on the quality, quantity, and well-being of our natural resources cannot reasonably be assessed on the basis of a statewide average. Protection of environmental values, in this respect, is a quintessential local issue that must be tailored to local conditions.

> Section 3215(d) marginalizes participation by residents, business owners, and their elected representatives with environmental and habitability concerns, whose interests Section 3215 ostensibly protects. *See* 58 PA. CONS. STAT. § 3202 (2011) (Declaration of purpose of chapter). The result is that Section 3215 fosters decisions regarding the environment and habitability that are non-responsive to local concerns; and, as with the uniformity requirement of Section 3304, the effect of failing to account for local conditions causes a disparate impact upon beneficiaries of the trust. Moreover, insofar as the Department of Environmental Protection is not required, but is merely permitted, to account for local concerns in its permit decisions, Section 3215(d) fails to ensure that any disparate effects are attenuated. Again, in-

tion of uniform rules interfered with the municipalities' duties as trustees under Article I, § 27, and that the rules were therefore unconstitutional.[29]

The plurality in *Robinson Township* based its construction of the ERA primarily on the plain language of the provision and its legislative history.[30] It found that its construction was supported by consideration of "the occasion and necessity for the constitutional provision, . . . the circumstances of enactment and ratification, the mischief to be remedied and the object to be attained."[31] The plurality discussed at length Pennsylvania's long history of environmental abuse in connection with coal mining, deforestation, pollution, and wildlife eradication.[32] These abuses provided the impetus for the ERA's adoption.[33] The opinion noted that the challenged law was written to encourage a gas extraction boom that posed the risk of causing similar environmental degradation.[34] In striking down the portions of the law that limited the power of local governments and state agencies to exercise their obligation as trustees to prevent degradation, diminution, and depletion of constitutionally protected natural resources, the plurality opinion articulated the following key legal principles:

- The rights provided by the first and second clauses of the ERA represent fundamental, individual rights akin to free speech, freedom of religion and other rights enumerated in Article I of the Pennsylvania Constitution, and they should be interpreted as such.[35]
- The first clause "affirms a limitation on the state's power to act contrary" to the people's right to "clean air, pure water, and the preservation of the natural, scenic, historic, and esthetic values of the environment." As a result, "laws of the Commonwealth that unreasonably impair the right are unconstitutional."[36]

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equitable treatment of trust beneficiaries is irreconcilable with the trustee duty of impartiality.

Id. at 984.

29. *Id.*

30. *See Robinson Twp.*, 83 A.3d at 950-959. For a complete legislative history, see John C. Dernbach & Edmund J. Sonnenberg, *A Legislative History of Article 1, Section 27 of the Constitution of the Commonwealth of Pennsylvania, Showing Source Documents* (2015), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2474660. A companion version that does not show photocopies of pages of source documents is John C. Dernbach & Edmund J. Sonnenberg, *Legislative History: Article 1, Section 27 of the Constitution of the Commonwealth of Pennsylvania*, 24 WIDENER L.J. 181 (2015).

31. *Robinson Twp.*, 83 A.3d at 960.

32. *Id.* at 960-963.

33. *Id.* at 961 ("With these events in the recent collective memory of the General Assembly, the proposed Environmental Rights Amendment received the unanimous assent of both chambers during both the 1969–1970 and 1971–1972 legislative sessions.").

34. *Id.* at 976.

35. *Id.* at 953-54, 976.

36. *Id.* at 951.

- "The drafters seemingly signaled an intent that the concept of public natural resources would be flexible to capture the full array of resources implicating the public interest, as these may be defined by statute or at common law."[37]
- The public natural resources that are made the property of all the people by the second clause and the subject of the Commonwealth's duty as a trustee include "not only state-owned lands, waterways, and mineral reserves, but also resources that implicate the public interest, such as ambient air, surface and ground water, wild flora, and fauna (including fish) that are outside the scope of purely private property."[38] The constitutional rights created by the second clause of the ERA include the right to enforce the duty of a trustee created by the third clause.[39]
- The public trust provisions of the ERA are self-executing, as they create constitutional duties that bind all three branches of state government, and they can be applied and enforced by the judicial branch without further legislative action.[40]
- The Commonwealth's duties as a trustee should be governed by the established law applicable to trusts and trustees, including the legal principles articulated in the Restatement of Trusts.[41] These trustee duties include prudence ("exercise[ing] ordinary skill, prudence and caution in managing corpus of trust"), loyalty (administering the trust "solely in beneficiary's" interest), and impartiality ("treat[ing] all [beneficiaries] equitably in light of the purposes of the trust").[42]

The plurality opinion, however, received votes from only three of the Court's seven justices.[43] Justice Baer supported the plurality's decision on a separate basis—substantive due process.[44] While the *Robinson Township* decision sketched a view of what Article I, § 27 could ultimately mean, it did not enshrine these principles as law.

37. *Id.* at 955.

38. *Id.*

39. *Id.* at 955-56.

The third clause of Section 27 establishes the Commonwealth's duties with respect to Pennsylvania's commonly-owned public natural resources, which are both negative (*i.e.*, prohibitory) and affirmative (*i.e.*, implicating enactment of legislation and regulations). The provision establishes the public trust doctrine with respect to these natural resources (the corpus of the trust) and designates 'the Commonwealth' as trustee and the people as the named beneficiaries.

40. *See id.* at 966-67.

41. *Id.* at 955-57.

42. *Id.* at 957, 959.

43. *Id.* at 1000.

44. *Id.* at 1000-1001.

II. THE DECISION IN *PEDF*

In *PEDF*, the Court reaffirmed the *Robinson Township* principles and made them the applicable law of Article I, § 27. The plaintiff in *PEDF* challenged a series of legislative enactments that eliminated requirements that revenues from gas development leases on state forest and park lands be used for conservation purposes; these enactments transferred oil and gas leasing revenues to the general fund.[45] The challenged legislation thus significantly changed the disposition of revenues dedicated to the Oil and Gas Lease Fund, administered by the Department of Conservation and Natural Resources (DCNR).[46] The Fund was created by a 1955 Act[47] requiring "[a]ll rents and royalties from oil and gas leases of any" Commonwealth land to be deposited in the fund and "exclusively used for conservation, recreation, dams, or flood control."[48] The challenged legislation transferred much of the money that would have been deposited in the Lease Fund to the General Fund, where it could be used for any purpose authorized by the General Assembly.[49] The challenged legislation also created a cap on revenues committed to DCNR under the Lease Fund, rather than requiring *all* moneys received from gas leasing to be used for conservation and maintenance of environmental trust resources.[50]

The plaintiff challenged these enactments in Commonwealth Court as violative of the public trust clauses of Article I, § 27.[51] The Commonwealth Court granted summary judgment to the Commonwealth, holding that there was no violation of the constitutional public trust.[52] In reversing the Commonwealth Court, a majority of the Court reaffirmed the breadth of the *Robinson Township* decision and

45. Pa. Envtl. Def. Found. v. Commonwealth, 161 A.3d 911, 916, 921-25 (Pa. 2017).

> Three legislative amendments to the state fiscal code between 2008 and 2014 redirected a total of $335 million that would have been used for conservation purposes under the [Lease Fund Act] to the general fund, where it is appropriated for a variety of state government purposes. In addition, the Legislature prevented DCNR from spending any [Lease Fund Act] royalties without prior legislative authorization. Finally, the Legislature began using [Lease Fund] revenue to support the overall budget of DCNR, rather than obtaining that budget money from the general fund and using [Lease Fund] money for conservation purposes related to oil and gas extraction.

Id. (citing John C. Dernbach, *The Potential Meanings of a Constitutional Public Trust*, 45 ENVTL. L. 463, 488 (2015) (internal citations omitted)).

46. *Id.*

47. Oil and Gas Lease Fund Act, 71 PA. CONS. STAT. § 1331 (2017).

48. *Id.*

49. *PEDF*, 161 A.3d at 921-24.

50. *Id.*

51. *Id.* at 925-26, 928

52. *Id.* at 928.

Article I, § 27 rights and duties, and it quoted extensively from *Robinson Township*.[53] The Court held:

> Because state parks and forests, including the oil and gas minerals therein, are part of the corpus of Pennsylvania's environmental public trust, we hold that the Commonwealth, as trustee, must manage them according to the plain language of Section 27, which imposes fiduciary duties consistent with Pennsylvania trust law. We further find that the constitutional language controls how the Commonwealth may dispose of any proceeds generated from the sale of its public natural resources.[54]

The Court's recitation of the facts suggests that the Court viewed the General Assembly's actions as looting a fund (the Lease Fund) dedicated to conservation of state forests and parks in order to fund a budget deficit in a way that would interfere with maintenance of those lands.[55] The Court found this change significant because "DCNR had anticipated receiving the full amount of the rents and royalties to allow it to oversee the rapid expansion of drilling on state land when it decided to enter into the 2008 Leases."[56] The legislation further restricted the environmental purposes for which the now-limited revenues going into the Lease Fund could be used.[57] The Court characterized the challenged actions as "transfers of capital."[58]

The portions of the opinion of greatest significance for regulation of GHGs relate to the standard of review under Article I, § 27 and the contours of the ERA.[59] The Court began by rejecting outright the three-part balancing test that had been used as a substitute for the text of the ERA, saying that the test "strips the constitutional provision of its meaning."[60] The Court then stated that the first two clauses of the ERA created rights that were "excepted out of the general powers of government" and that those rights, like all other rights articulated in Article

53. *Id.* at 916-921 (quoting Robinson Twp. v. Commonwealth, 83 A.3d 901, 960-63 (Pa. 2013) (plurality)), 929-933, 936, 938.

54. *PEDF*, 161 A.3d at 916.

55. *See* Robinson Twp. v. Commonwealth, 83 A.3d 901, 955-56 (Pa. 2013) (plurality).

> The third clause of Section 27 establishes the Commonwealth's duties with respect to Pennsylvania's commonly-owned public natural resources, which are both negative (*i.e.*, prohibitory) and affirmative (*i.e.*, implicating enactment of legislation and regulations). The provision establishes the public trust doctrine with respect to these natural resources (the corpus of the trust) and designates 'the Commonwealth' as trustee and the people as the named beneficiaries.

Id.

56. *PEDF*, 161 A.3d at 922.

57. *Id.*

58. *Id.* at 924.

59. *Id.* at 930-36.

60. *Id.* at 930.

I of the Pennsylvania Constitution, "shall forever remain inviolate."[61] It noted that the "public natural resources"[62] that were made the property of the people included both the state forest and park lands and "the oil and gas themselves."[63] The Court explained that the original draft of the second sentence of the ERA provided that the property of the people (including future generations) extended to "'Pennsylvania's natural resources, including the air, waters, fish, wildlife, and the public lands and property of the Commonwealth. . . .' The Court further explained that this language was revised to remove the enumerated list and thereby discourage courts from limiting the scope of natural resources covered." Because there was no stated problem with the list of natural resources contained in the original draft, the list in the original draft of the second sentence represents a minimum list of the public natural resources protected by the ERA.[64] The items on this list are therefore the property of all the people.[65]

The Court then elaborated on the trustee duties created by the third clause of the ERA, adopting the *Robinson Township* interpretation of that clause as imposing upon the Commonwealth a fiduciary duty equivalent to that imposed upon trustees by existing trust law, with that duty extending to the public, including future generations.[66] The Court discussed the applicable duties imposed on trustees as set forth in the Restatement (Second) of Trusts, noting that these duties include the requirement that a trustee "manage the trust so as to give all of the beneficiaries due regard for their respective interests in light of the purposes of the trust."[67] The Court summarized the duties created by Article I, § 27, as follows:

> Pennsylvania's environmental trust thus imposes two basic duties on the Commonwealth as the trustee. First, the Commonwealth has a duty to prohibit the degradation, diminution, and depletion of our public natural resources, whether these harms might result from direct state action or from the actions of private parties. Second, the Commonwealth must act affirmatively via legislative action to protect the environment. Although a trustee is empowered to exercise discretion with respect to the proper

61. *Id.* at 930-31 (quoting Robinson Twp. v. Commonwealth, 83 A.3d 901, 948 (Pa. 2013) (plurality), quoting PA. CONST. art. I, § 25).

62. *Id.* at 931.

63. *Id.*

64. *Id.*

65. *Id.* (citing PA. LEGIS. JOURNAL, 154th General Assembly, No. 118, Reg. Sess., 2274 (1970) (Broughton Analysis)). In a footnote, the Court explained that the word "public" was added to modify "natural resources" to indicate that the public's rights and the trust obligations did not extend to "purely private property rights." The Court also noted that the ERA's author and principal advocate opined that that this limitation did not apply to resources, such as those originally enumerated, that "involve a public interest." *Id.*, n.22 (quoting PA. LEGIS. JOURNAL, 154th General Assembly, No. 118, Reg. Sess., 2271-72 (1970) (statement by Rep. Kury)).

66. Pa. Envtl. Def. Found. v. Commonwealth, 161 A.3d 911, 932 (Pa. 2017).

67. *Id.* at 933.

> treatment of the corpus of the trust, that discretion is limited by the purpose of the trust and the trustee's fiduciary duties, and does not equate "to mere subjective judgment." The trustee may use the assets of the trust "only for purposes authorized by the trust or necessary for the preservation of the trust; other uses are beyond the scope of the discretion conferred, even where the trustee claims to be acting solely to advance other discrete interests of the beneficiaries."[68]

In a footnote, the Court expressly rejected the dissent's contention that its holding would cordon off hundreds of millions of dollars for other budgetary uses, noting that this question was never raised and was not before the Court.[69]

Consequently, the Court held that if the trustee was disposing of the assets of the trust, it was bound to use the proceeds in ways necessary and appropriate for carrying out the purposes of the trust, which in the case of the ERA was the maintenance and conservation of public natural resources.[70] The Court rejected the plaintiff's argument that "all revenues generated by oil and gas leases [needed to] remain in the corpus of the trust."[71] It held that the royalties arose from the sale of principal and were therefore in the trust.[72] The Court said it was less clear how to categorize other revenue streams from gas leasing, and that additional advocacy was required to determine whether those revenues constituted principal or income.[73]

Reaffirming the plurality opinion in *Robinson Township*, the Court rejected an argument raised by the Republican Caucus of the General Assembly that the public trust provisions of Article I, § 27 were not self-executing but instead required implementing legislation.[74] It also reaffirmed the *Robinson Township* plurality opinion "that the Commonwealth's obligations as trustee 'create a right in the people to seek to enforce the obligations.'"[75]

Applying its explanation of Article I, § 27 to the legislation at issue, the Court concluded that in transferring royalties from a restricted fund to the unrestricted General Fund, the Commonwealth did not "contemplate, let alone reasonably exercise, its duties as the trustee of the environmental public trust created by the" ERA.[76] The Court thus invalidated the provisions relating to the transfer of royalties,[77] which meant that the prior statutory dedication of the Lease Fund resources

68. *Id.* (internal citations omitted).

69. *Id.* at n.25.

70. *Id.* at 933-35.

71. *Id.* at 935.

72. *Id.*

73. *Id.* at 935-36.

74. *Id.* at 936-37.

75. *Id.* at 937.

76. *See id.*

77. *Id.* at 937-38.

to DCNR applied.[78] The Court emphasized that its holding did not require that the revenues constituting the corpus of the trust be included in the restricted fund or even be dedicated to DCNR, as long as the funds were used for the purpose of the trust, *viz*. "maintenance and conservation" of Article I, § 27 resources.[79] The matter was remanded to the Commonwealth Court to make a determination with respect to other revenues.[80]

III. ARTICLE I, § 27 APPLIES TO CLIMATE DISRUPTION

Climate disruption already adversely affects Pennsylvania, and these adverse effects will increase over time. The severity of future impacts depends to a great extent on what actions are taken to reduce greenhouse gas emissions and even remove carbon dioxide from the atmosphere.[81] Yet under Article I, §27, the people of the Commonwealth have a right to a natural climate that is not disrupted by excessive concentrations of GHGs in the atmosphere. In addition, the Commonwealth has a commensurate duty to limit emissions to prevent climate disruption.

A. *The Impact of Climate Disruption on Pennsylvania*

The existing and projected adverse effects of climate change on the nation and the world have been well documented and explained. Sources include the U.S. Environmental Protection Agency's 2009 finding under the Clean Air Act that emissions of greenhouse gases from motor vehicles may reasonably be expected to endanger public health and welfare, which was upheld on judicial review.[82] They also include multiple reports of the U.S. Global Change Research Program, including its 2017 report;[83] multiple reports of the National Research Council (NRC) of the

78. *Id.* at 939.

79. *Id.* at 939.

80. *Id.*

81. TIM FLANNERY, THE WEATHER MAKERS 167-202 (2005); RICHARD B. ALLEY, THE TWO -MILE TIME MACHINE 181-92 (2000), https://muse.jhu.edu/book/36460.

82. Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act; Final Rule, 74 Fed. Reg. 66,496, 66,497 66,514 (Dec. 15, 2009) [hereinafter Endangerment Finding], *aff'd* Coal. for Responsible Regulation, Inc. v. U.S. Envtl. Prot. Agency, 684 F.3d 102 (D.C. Cir. 2012), *aff'd in part and rev'd in part on other grounds sub nom.* Utility Air Regulatory Grp. v. Envtl. Prot. Agency, 134 S. Ct. 2427 (2014) (*UARG*).

83. *See, e.g.*, U.S. GLOBAL CHANGE RESEARCH PROGRAM, CLIMATE SCIENCE SPECIAL REPORT: FOURTH NATIONAL CLIMATE ASSESSMENT, VOLUME I (2017), https://science2017.globalchange.gov/downloads/CSSR2017_FullReport.pdf; *see also* John C. Dernbach & Robert Altenburg, *Evolution of U.S. Climate Policy*, *in* GLOBAL CLIMATE CHANGE AND U.S. LAW 84-87 (Michael B. Gerrard & Jody Freeman eds. 2014) (explaining authorizing legislation for U.S. Global Change Research Program and describing some earlier reports).

National Academy of Sciences;[84] the reports of the Intergovernmental Panel on Climate Change;[85] numerous reports of other national academies of science;[86] and even judicial decisions.[87]

State-specific information also exists for Pennsylvania. The Pennsylvania Climate Change Act requires the Department of Environmental Protection (DEP) to produce a report every three years on the actual and projected impacts of climate change on the state.[88] DEP's 2015 report on the impacts of climate change in Pennsylvania[89] makes clear that the effects of climate disruption on Pennsylvania's public natural resources are likely to exceed the impacts of uncontrolled coal mining, deforestation, and industrial development that motivated Section 27's adoption. These historical effects are described in *Robinson Township* and *PEDF* at length.[90] The 2015 Pennsylvania report explains that GHGs in the atmosphere are already reaching the point that will cause an increase in temperature from pre-industrial levels, and their continued emissions will cause an increase much higher than 2°C above pre-industrial levels by mid-century.[91] According to that report, "Pennsylvania has undergone a long-term warming of more than 1°C (1.8°F) over the past 110 years."[92] It also projects an increase of about 3°C (5.4°F) between 2000 and 2050, which means that the "current warming trend is expected to continue at an accelerated rate."[93] As discussed below, it will be necessary to keep temperature increases well below 2°C and desirable to keep them below 1.5°C to prevent serious climate disruption.[94]

84. *See, e.g.*, NAT'L RESEARCH COUNCIL, CLIMATE CHANGE 2013: THE PHYSICAL SCIENCE BASIS (2013), http://www.ipcc.ch/report/ar5/wg1/; NAT'L RESEARCH COUNCIL, CLIMATE STABILIZATION TARGETS: EMISSIONS, CONCENTRATIONS, AND IMPACTS OVER DECADES TO MILLENNIA (2011), https://www.nap.edu/catalog/12877/climate-stabilization-targets-emissions-concentrations-and-impacts-over-decades-to; NAT'L RESEARCH COUNCIL, ABRUPT IMPACTS OF CLIMATE CHANGE: ANTICIPATING SURPRISES (2013), https://www.nap.edu/catalog/18373/abrupt-impacts-of-climate-change-anticipating-surprises.

85. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, FIFTH ASSESSMENT REPORT (AR5) (2014), http://www.ipcc.ch/report/ar5/index.shtml.

86. *See, e.g.*, ROYAL SOCIETY, CLIMATE CHANGE: A SUMMARY OF THE SCIENCE (2010), https://royalsociety.org/topics-policy/publications/2010/climate-change-summary-science/.

87. *See Coal. for Responsible Regulation, Inc.*, 684 F.3d 102; *see also* Green Mt. Chrysler Plymouth Dodge Jeep v. Crombie, 508 F. Supp. 295, 307-310 (D. Vt. 2007).

88. Pennsylvania Climate Change Act, 71 PA. CONS. STAT. § 1361.3 (2017).

89. JAMES SHORTLE, ET AL., PENNSYLVANIA CLIMATE IMPACTS ASSESSMENT UPDATE (May 2015) [hereinafter PA CLIMATE IMPACTS]. The report was required by the Pennsylvania Climate Change Act, 71 Pa. C.S. § 1361.3.

90. Robinson Twp. v. Commonwealth, 83 A.3d 901, 960-63 (Pa. 2013) (plurality), *quoted in* Pa. Envtl. Def. Found. v. Commonwealth, 161 A.3d 911, 916-21 (Pa. 2017).

91. *See generally* PA CLIMATE IMPACTS, *supra* note 89.

92. *Id.* at 6 ("Changes in Pennsylvania's temperature are reflected in other metrics, such as heating degree days (which have increased) and cooling degree days (which have decreased).").

93. *Id.* at 7.

94. *See infra* Section V.A.

This warming is, and will continue to be, accompanied by a parallel trend in increasing precipitation.[95] "The corresponding annual precipitation increase is expected to be 8%, with a winter increase of 14%."[96] The report does not say—and could not say—that warming and precipitation trends will stabilize in 2050.[97]

Climate change, the report says, will also increase air pollution and will likely make water pollution worse. On air pollution, the report states:

> Climate change will worsen air quality relative to what it would otherwise be, causing increased respiratory and cardiac illness. The linkage between climate change and air quality is most strongly established for ground-level ozone creation during summer, but there is some evidence that higher temperatures and higher precipitation will result in increased allergen (pollen and mold) levels as well.[98]

Climate change will also likely increase water pollution:

> Climate change can potentially also worsen water quality, affecting health through drinking water and through contact during outdoor recreation. The two primary mechanisms through which climate change could affect surface water quality are 1) increased pathogen loads due to increased surface runoff from livestock farms, sewer overflows, and resuspension of pathogens in river sediments during heavy rainstorms, and 2) increased risk of harmful algal blooms in eutrophied lakes and reservoirs.[99]

Although there may be some beneficial impacts from these changes, the Pennsylvania climate impacts report indicates that the adverse effects on Pennsylvania's public natural resources will dwarf any positive impacts.[100] Higher temperatures will stress the dairy industry and require increased energy use.[101] It will also cause forest types to change, lead to increased mortality in the forests, and interfere with forest regeneration.[102] Increased temperatures may increase the prevalence of vector-borne diseases.[103] Climate change will have "a severe, negative impact on winter recreation," so that "Pennsylvania's downhill ski and snowboard resorts are not expected to remain economically viable past mid-century."[104] Some areas will no

95. PA CLIMATE IMPACTS, *supra* note 89, at 6-7.

96. *Id.* at 7.

97. *See id.*

98. *Id.* at 11.

99. *Id.* at 11, 14. In addition, "climate change will worsen the currently substandard water quality in the tidal freshwater region of the Delaware Estuary." *Id.*

100. *See id.*

101. *Id.* at 8.

102. *Id.* at 9-10.

103. *Id.* at 11.

104. *Id.*

longer be able to support trout.[105] Flood risks will increase throughout the Commonwealth.[106] Moreover, sea level rise will affect the Delaware estuary, inundating some areas and causing an increase in salinity.[107]

Reports published since 2015 have determined that the adverse impacts of climate disruption on public natural resources will be more severe than those identified in the Pennsylvania climate impacts report. One more recent report indicates that sea level rise due to melting glaciers will be more extensive, such that some parts of Tinicum National Wildlife Refuge and Philadelphia International Airport will be inundated before the end of the century.[108] Another indicates that adverse impacts on plants and wildlife will be particularly severe, even with the emissions reductions that will be achieved under the current pledges in the Paris Agreement on climate change.[109] That study concluded that with the current pledges, temperatures would increase by approximated 3.2°C, reducing the ranges by more than 50% for approximately 49% of insect species, 44% of plant species and 26% of vertebrate species, and dramatically increasing their risk of extinction.[110] With greater GHG emission reductions that would limit temperature increases to the Paris Agreement's goals of 2°C and 1.5°C, the damage will be substantially less.[111] These species, of course, include species in Pennsylvania.

Nor will the impacts of climate disruption be evenly distributed. Low income and minority communities are likely to be more severely affected because of "lack of air conditioning, greater prevalence of pre-existing health conditions, location and condition of housing, inadequate access to transportation, relatively greater rates of under-insurance, and concentrations in strenuous occupations."[112] In addi-

105. *Id.* at 12.

106. *Id.*

107. *Id.* at 14.

108. A study published in 2018 based on 25 years of satellite data showed accelerated rates of sea level rise driven by the melting of the Greenland and Antarctic ice sheets and predicted that, if these rates continue, sea levels would rise by 65 centimeters, or 26 inches, by 2100 compared to past estimates. R. S. Nerem et al., *Climate-change–driven Accelerated Sea-Level Rise Detected in the Altimeter Era*, 115 PROC. NAT'L ACAD. SCI. 2022, 2022 (2018), https://doi.org/10.1073/pnas.1717312115. The last IPCC assessment estimated that sea levels could rise from between 44 cm and 74 cm by 2100, so that the 2018 study suggests that sea level rise will be approximately two times that estimate or 109 to 139 cm, or approximately four feet. John A. Church et al., Intergovernmental Panel on Climate Change, *Sea Level Change, in* CLIMATE CHANGE 2013: THE PHYSICAL SCIENCE BASIS, Chapter 13, at 1182, Table 13.5 (2013), http://www.ipcc.ch/report/ar5/wg1/. Because Tinicum marsh and the airport are located in tidal areas of the Delaware Estuary, significant portions would be inundated.

109. R. Warren et al., *The Projected Effects on Insects, Vertebrates, and Plants of Limiting Global Warming to 1.5°C Rather Than 2°C*, 360 SCIENCE 791, 791 (2018).

110. *Id.*

111. At 2°C these numbers fall to 18% of insects, 16% of plants, and 26% of vertebrates, and at 1.5ºC they fall further to 6% of insects, 8% of plants, and 4% of vertebrates. *Id.*

112. Shelley Welton, *Clean Electrification*, 88 U. COLO. L. REV. 571, 627-28 (2017) (citing IPCC and other studies).

tion, because climate change will likely increase the price of water, food, and even energy, it will also disproportionately affect households with lower incomes.[113]

Three additional points need to be made about this information, and they all suggest that these impacts will be greater than indicated in the Pennsylvania report, the EPA's endangerment finding, and other reports. Most obviously, perhaps, these analyses are mostly silent on impacts after 2050 or any other future date. There is no scientific reason to believe that warming will stabilize by those dates; indeed, in business-as-usual scenarios, warming continues after those dates.[114]

Second, it is very likely that the impacts of climate disruption will increase over time, and that any damages occurring after 2050 will be far greater than those discussed in the Pennsylvania report and other sources. Yet many cost-benefit analyses discount costs to future generations, thus reducing these calculated future costs to an insignificant number.[115]

Third, the damage estimates in the Pennsylvania assessment and other reports tend not to account for the possibility of catastrophic climate disruption. There are potentially significant risks of catastrophic results if GHG emissions are not reduced and eliminated in a sufficiently timely manner.[116] The end Permian mass

113. *Id.* at 628-29.

114. Nebojsa Nakicenovic & Rob Swart, *Emissions Scenarios*, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, http://www.ipcc.ch/ipccreports/sres/emission/index.php?idp=115, (last visited Apr. 15, 2018); INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2014 SYNTHESIS REPORT SUMMARY FOR POLICYMAKERS 11 (2014).

115. Many ethicists question whether the cost of future climate disruption affecting future unborn generations should be discounted at all. In one of the first assessments of the ethical implications of climate change, a group of ethicists noted:

> Proponents of discounting in CBA urge that the value of future environmental benefits be determined in the same way that the market applies value to future events—that is by understanding the present value of future benefits. When such discounting occurs, benefits from climate change policy options that will accrue far in the future are given little present value. Such an approach makes current investors' interests, not future generations' welfare, the focus of concern.

DONALD BROWN ET AL., WHITE PAPER ON THE ETHICAL DIMENSIONS OF CLIMATE CHANGE 29, (2006). These ethicists further concluded:

> Because discounting benefits in CBA assumes only contemporary investor-individuals' interests count in determining worth, discounting techniques in CBA can violate interests of future generations to have a global climate system that has not been degraded by human activities. Since nations agreed in the adopting the UNFCCC to protect the interests of future generations, discounting benefits and harms in CBAs can violate the duty of nations to keep promises made in treaties.

Id. at 32. These concerns were more recently echoed by Pope Francis in his encyclical letter, which, without addressing discounting per se, condemned placing short term current interests ahead of the interest of future generations. *See* POPE FRANCIS, ENCYCLICAL LETTER, LAUDATO SI' OF THE HOLY FATHER FRANCIS ON CARE FOR OUR COMMON HOME 1118-1120 (2015).

116. Massachusetts v. Envtl. Prot. Agency, 549 U.S. 497, 521-22 (2007)

extinction presents an extreme example of the potential high risk; 90% or more of all life on Earth died following a rapid (in geological terms) increase in carbon dioxide that occurred when volcanic action burned significant coal-bearing strata.[117] Most analyses of the social cost of carbon, which as discussed below measures the cost of the future damages caused by emitting a ton of carbon dioxide today, fail to account for the risk of catastrophic results. For climate disruption, the probabilistic curve plotting likelihood versus damage is unusual in that it has a very long tail, representing low probability catastrophic cost possibilities.[118] In markets, the risk of such catastrophic events suggests that, rather than discounting, we should pay a premium to prevent them, just as we pay a premium for riskier stocks over safer bonds.[119] A model incorporating consideration of risk of catastrophic results far less significant than the end Permian mass extinction has calculated that in 2015 carbon dioxide should have been priced or taxed at about $125 per ton.[120] The same model shows that each year that action is delayed will increase damages by $700 billion per year "and a 15 year delay would cost roughly $180 trillion, about six times current annual global consumption."[121]

> According to the climate scientist Michael MacCracken, "qualified scientific experts involved in climate change research" have reached a "strong consensus" that global warming threatens (among other things) a precipitate rise in sea levels by the end of the century, MacCracken Decl. ¶ 15, Stdg.App. 207, "severe and irreversible changes to natural ecosystems," *id.,* ¶ 5(d), at 209, a "significant reduction in water storage in winter snowpack in mountainous regions with direct and important economic consequences," *id.,* and an increase in the spread of disease, *id.,* ¶ 28, at 218-219. He also observes that rising ocean temperatures may contribute to the ferocity of hurricanes. *Id.*, ¶¶ 23-25, at 216-217.

Id.

See, e.g., R. B. Alley et al., *Abrupt Climate Change*, 299 SCIENCE 2005, 2008 (2016); James Hansen, et al., *Icemelt, Sea Level Rise and Superstorms: Evidence from Paleoclimate Data, Climate Modeling, and Modern Observations that 2ºC Global Warming Could Be Dangerous,* 16 ATMOSPHERIC CHEMISTRY & PHYSICS 3761, 3762 (2016) [hereinafter Hansen et al, *Ice Melt*]; James Hansen et al., *Global Temperature Change,* 103 PROC. NAT'L ACAD. SCI.14288, 14292-93 (2006); T.M.L. Wigley, *The Climate Change Commitment*, 307 SCIENCE 1766, 1767-68 (2005).

117. Raymond B. Huey & Peter D. Ward, *Hypoxia, Global Warming and Terrestrial Late Permian Extinctions*, 308 SCIENCE 398 (2005); FLANNERY, *supra* note 81 at 200-01; JAMES HANSEN, STORMS OF MY GRANDCHILDREN: THE TRUTH ABOUT THE COMING CLIMATE CATASTROPHE AND OUR LAST CHANCE TO SAVE HUMANITY 144-50 (2009) [hereinafter STORMS].

118. *See* Matthew Collins et al., *Long Term Climate Change: Projections, Commitments, and Irreversibility*, *in* CLIMATE CHANGE 2013: THE PHYSICAL SCIENCE BASIS, CONTRIBUTION OF WORKING GROUP I TO THE FIFTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL REPORT ON CLIMATE CHANGE 1029, 1114-19 (Sylvie Joussaume, Abdalah Mokssit, Karl Taylor, Simon Tett eds. 2013).

119. JERRY TAYLOR, THE CONSERVATIVE CASE FOR A CARBON TAX 13-15 (2015), http://niskanencenter.org/wp-content/uploads/2015/03/The-Conservative-Case-for-a-Carbon-Tax1.pdf.

120. KENT D. DANIEL, ROBERT B. LITTERMAN, & GERNOT WAGNER, APPLYING ASSET PRICING THEORY TO CALIBRATE THE PRICE OF CLIMATE RISK 25 (2017) (revised draft), https://gwagner.com/wp-content/uploads/DLW-Asset-Pricing-Climate-Risk-171113.pdf.

121. *Id.* at 41.

B. *Both the First and Second Clauses of Article I, § 27 Extend to the Natural Climate Unaffected by Climate Disruption*

1. Scope of Article I, § 27

Although the climate is not expressly protected under the ERA, the ERA's language and legislative history, as well as the reasoning of both *Robinson Township* and *PEDF*, all compel the conclusion that a climate free of human disruption is protected by Article I, § 27.

The right to a natural climate unaffected by climate disruption is included within the ERA's first clause, which protects the people of Pennsylvania's right to "clean air, pure water, and to the preservation of the natural, scenic, historic and esthetic values of the environment."[122] The Pennsylvania report indicates that a warming climate will adversely affect air quality, thus compromising the people's right to clean air.[123] The report also indicates that a warming climate will likely lead to greater water pollution, increased flooding, and sea level rise, thus compromising the people's right to clean water.[124]

The *Robinson Township* plurality "recognize[d] that, as a practical matter, air and water quality have relative rather than absolute attributes."[125] As is the case with most other conventional water and air pollutants, carbon dioxide is a naturally occurring substance necessary for life and the maintenance of the climate, and it is only when the concentration of the pollutant becomes too high that natural processes are disrupted. For example, when the ERA recognizes a right to "pure water," this means water with levels of nutrients that support the normal functioning of aquatic ecosystems, and that conserves and maintains public natural resources, but not so high as to cause eutrophication.[126] Likewise, when the ERA recognizes a right to "clean air," it means, as applied to carbon dioxide, levels necessary to support plant life and ecosystems, among other things, but not so high as to disrupt ecosystems, as will occur in climate disruption. Similarly, "pure water" means water with levels of carbon dioxide that support the normal functioning of aquatic ecosystems, and that conserves and maintains public natural resources, but not so high as to acidify the water and disrupt those natural systems.

In addition to clean air and water, a stable climate also provides critical natural and historic values of the environment. There can be little doubt that the relatively stable climate that has persisted since the end of the last Ice Age facilitated the rise

122. PA CONST. art. I, § 27, cl. 1.

123. PA CLIMATE IMPACTS, *supra* note 89, at 132.

124. *Id.*

125. Robinson Twp. v. Commonwealth, 83 A.3d 901, 953 (Pa. 2013) (plurality).

126. Nitrogen compounds and phosphorus in water are necessary for supporting the plant life that supports the aquatic ecosystem, but when levels of these substances become too high eutrophication occurs and depletes oxygen, killing aquatic organisms and disrupting aquatic ecosystems are disrupted. Likewise, chromium is a heavy metal essential to life that we include in vitamin pills, but at too high a level it becomes a poison.

of civilization.[127] As the reports described above indicate, a stable climate also prevents the increasing incidence of vector-borne diseases and adverse effects from air pollution[128] and protects winter recreation.[129] The assessments discussed above also establish that climate disruption will impair scenic and esthetic values of the environment by causing dramatic changes in forests and agriculture and by reducing or eliminating key species like trout.[130]

In addition, the right to a natural climate unaffected by human-caused climate disruption is included within the second clause's protection of the public's right to the conservation and maintenance of public natural resources. The *Robinson Township* plurality emphasized that the concept of public natural resources encompassed a wide range of values of the natural environment:

> At present, the concept of public natural resources includes not only state-owned lands, waterways, and mineral reserves, but also resources that implicate the public interest, such as ambient air, surface and ground water, wild flora, and fauna (including fish) that are outside the scope of purely private property.[131]

Catastrophic climate disruption would radically impair and possibly eliminate the "wild flora, and fauna (including fish),"[132] public forests and their ecosystems, and game and wildlife[133] that the plurality in *Robinson Township* expressly recognized as falling within the public trust obligations of the second and third clauses of Article I, § 27.[134]

The Court in *PEDF* and the *Robinson Township* plurality both cite the ERA's legislative history as supporting a broad construction of the public natural resources that are made the property of all the people. As indicated earlier, the *Robinson Township* plurality noted:

> [A]fter members of the General Assembly expressed disquietude that the enumeration of resources would be interpreted "to limit, rather than expand, [the] basic concept" of public natural resources, Section 27 was amended and subsequently adopted in its existing, unrestricted, form. The drafters seemingly signaled an intent that the concept of public natu-

127. *See* RICHARD ALLEY, THE TWO-MILE TIME MACHINE: ICE CORES, ABRUPT CLIMATE CHANGE, AND OUR FUTURE (Princeton Univ. Press 2000); STORMS, *supra* note 117, at 39-40.

128. PA CLIMATE IMPACTS, *supra* note 89, at 11.

129. *Id.* at 11-12.

130. *Id.* at 8-10 (agriculture and forestry), 12 (trout),

131. Robinson Twp. v. Commonwealth, 83 A.3d 901, 955 (Pa. 2013) (plurality); *accord* Pa. Envtl. Def. Found. v. Commonwealth, 161 A.3d 911, 931 (Pa. 2017).

132. *Robinson Twp.*, 83 A.3d at 955.

133. *Id.*; *see also* Huey & Ward, *supra* note 117 (such catastrophic climate disruption has harmed forests in the past); Alley et al., *supra* note 116; Warren et al., *supra* note 109.

134. *Robinson Twp.*, 83 A.3d at 955.

> ral resources would be flexible to capture the full array of resources implicating the public interest, as these may be defined by statute or at common law.[135]

The Court in *PEDF* similarly explained that the removal of the specific list and its replacement with more general language was intended to "discourage courts from limiting the scope of natural resources covered."[136]

The climate is not a private resource. Rather, the climate represents the seasonal average ranges of temperature, precipitation and other atmospheric conditions in a particular area over a long period of time.[137] Climate determines the nature of wild and other naturally occurring vegetation, fish and other wildlife; the amount and quality of ground and surface water; the characteristics of soils; the flow and extent of streams, rivers and wetlands; air quality; and most other characteristics of naturally occurring ecosystems and natural communities. These considerations all compel the conclusion that a stable climate, not disrupted by the types of changes caused by human emissions of GHGs in the atmosphere, should be understood as a public natural resource to which the people have a right and which the Commonwealth has a trustee's duty to conserve and maintain.[138]

However, under the express words of the ERA, the Commonwealth does not have a duty to "preserve" Pennsylvania's climate unchanged.[139] Indeed, it would be impossible for the Commonwealth to do so, given the international nature of the problem and the fact that many future changes will occur because of the current levels of greenhouse gases in the atmosphere. However, as noted by the *Robinson Township* plurality, the constitutional provision uses the words "conserve and maintain," rather than "preserve."[140] This means that "the duties to conserve and maintain are tempered by legitimate development tending to improve upon the lot of Pennsylvania's citizenry, with the evident goal of promoting sustainable development."[141] In further support of this proposition, the plurality cited the Montana Supreme Court's holding that a constitutional provision providing an "inaliena-

135. *Id.* (citing 1970 PA. LEGIS. JOURNAL–HOUSE at 2271–75).

136. *PEDF*, 161 A.3d at 931.

137. *Climate*, MERRIAM-WEBSTER, https://www.merriam-webster.com/dictionary/climate (last visited Apr. 26, 2018); *see also* FLANNERY, *supra* note 81 at 19-26.

138. *Cf. In re* Application of Maui Elec. Co., 141 P.3d. 1 (Haw. 2017). The case involved a challenge by citizens to a power purchase agreement with a fossil-fuel-fired power plant. The Hawai'i Constitution guarantees each person "the right to a clean and healthful environment, as defined by laws relating to environmental quality." HAW. CONST. art. XI, § 9. The court held that the petitioners demonstrated "a threatened injury to the[ir] right to a clean and healthful environment from the effect of greenhouse gas emissions," and thus had a right to a hearing on their claims. In other words, the right to a "clean and healthful environment" in Hawai'i includes a right to be protected against human-caused climate change.

139. Robinson Twp. v. Commonwealth, 83 A.3d 901, 948 (Pa. 2013) (plurality).

140. *Id.*

141. *Id.*

ble . . . right to a clean and healthful environment"[142] did "not protect merely against type[s] of environmental degradation 'conclusively linked' to ill health or physical endangerment and animal death, but could be invoked to provide anticipatory and preventative protection against unreasonable degradation of natural resources."[143]

Finally, the public trust rights under Article I, § 27 inhere in "all the people including generations yet to come."[144] Thus, the virtual certainty that effects of climate disruption will be inequitably distributed and will have greater impacts on generations yet to come[145] implicates Article I, § 27 even if only some people are adversely affected. As the *Robinson Township* plurality explained, disparate effects are "irreconcilable with the express command that the trustee will manage the corpus of the trust for the benefit of 'all the people.' "[146] The Commonwealth's obligation also derives from the trustee responsibility of impartiality. "Dealing impartially with all beneficiaries means that the trustee must treat all equitably in light of the purposes of the trust."[147] For many reasons, the right to a natural climate unaffected by human-caused climate disruption is protected under both parts of Article I, § 27.

2. Commonwealth Duties Concerning Climate Disruption

The Commonwealth has several overall duties under Article I, § 27 concerning climate disruption. Under the first clause, the Commonwealth may not act contrary to the people's right to a natural climate unaffected by climate disruption; "laws

142. *Id.* at 953 (citations omitted).

143. *Id.*

144. PA. CONST. art. I, § 27, cl. 2.

145. *See, e.g.*, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2014 SYNTHESIS REPORT SUMMARY FOR POLICYMAKERS 17 (2014).

> Without additional mitigation efforts beyond those in place today, and even with adaptation, warming by the end of the 21st century will lead to high to very high risk of severe, widespread and irreversible impacts globally (high confidence). Mitigation involves some level of co-benefits and of risks due to adverse side effects, but these risks do not involve the same possibility of severe, widespread and irreversible impacts as risks from climate change, increasing the benefits from near-term mitigation efforts.

Id.

See also Richard L. Revesz & Matthrew R. Shahabian, *Climate Change and Future Generations*, 84 S. CAL. L. REV. 1097 (2010-2011); Kevin Clarke, *How Will Climate Change Affect the Next Generation?* U.S. CATHOLIC, Oct. 2013, at 39, http://www.uscatholic.org/articles/201309/how-will-climate-change-affect-next-generation-27900.

146. Robinson Twp. v. Commonwealth, 83 A.3d 901, 980 (Pa. 2013) (plurality).

147. *Id.* at 959. Thus, legislative decisions under which "some properties and communities will carry much heavier environmental and habitability burdens than others" are inconsistent with the obligation that the trustee act for the benefit of "all the people." *Id.* at 1007 (using this argument to justify its decision that Section 3304 of Act 13 violates Article I, § 27).

of the Commonwealth that unreasonably impair the right are unconstitutional."[148] Under the second and third clauses of the public trust provisions of Article I, § 27, the Commonwealth has two duties. One is "to prohibit the degradation, diminution, and depletion"[149] of a natural climate unaffected by human-caused climate disruption, whether harm to the climate results "from direct state action or from the actions of private parties."[150] The other is "to act affirmatively via legislative action"[151] to conserve the natural climate and prevent undue disruption.[152] A third duty, which stems from the duty of private trust law duty of prudence, is that the Commonwealth must analyze the effect of its decisions on the public's right to be protected against climate change prior to making them.[153]

The inclusion of a right to a natural climate not disrupted by GHG pollution has three additional consequences for the Commonwealth as it interprets and applies existing statutes, regulations, and other laws. These consequences, in which Article I, § 27 plays more of a supporting role in the implementation of existing law, are based on cases decided before *Robinson Township* and *PEDF*.[154] The first of these involves the scope of the police power exercised by the state and local governments.[155] As a consequence of *PEDF*, state and local police power is constrained by a duty not to violate Article I, § 27 and an obligation to properly implement the public trust responsibilities.[156] These constraints and obligations apply to human-caused climate disruption. In addition, the Commonwealth has an obligation to interpret that law in a way that furthers constitutional rights when the meaning of a statute, regulation, or other law is unclear.[157] As a result, the Commonwealth has an obligation to interpret ambiguous laws in a way that furthers the constitutional right of people to be protected against human-caused climate change. Finally, Pennsylvania courts have previously used Article I, § 27 to support the constitutionality of laws that have been challenged on other grounds, including challenges to executive action based on claims that the action lacked sufficient statutory au-

148. *Robinson Twp.*, 83 A.3d at 951; Pa. Envtl. Def. Found. v. Commonwealth, 161 A.3d 911, 931 (Pa. 2017).

149. *PEDF*, 161 A.3d at 933.

150. *Id.*

151. *Id.*

152. *Id.*

153. *Id.* at 937 (quoting Payne v. Kassab, 312 A.2d 86, 94 (Pa. Commw. Ct. 1973), *aff'd* 361 A.2d 263 (Pa. 1976)).

154. Dernbach, *supra* note 5, at 150-61.

155. *Id.* at 150-56; John C. Dernbach, *The Potential Meanings of a Constitutional Public Trust*, 45 ENVTL. L. 463, 515-16 (2015).

156. Pa. Envtl. Def. Found. v. Commonwealth, 161 A.3d 911, 938 (Pa. 2017).

157. Dernbach, *supra* note 5, at 156-58; 1 PA. CONS. STAT. § 1922 (1970) ("In ascertaining the intention of the General Assembly in the enactment of a statute the following presumptions, among others, may be used: . . .3. That the General Assembly does not intend to violate the Constitution of the United States or of this Commonwealth.").

thorization.[158] It follows that legal challenges to Commonwealth actions to protect against climate disruption could be defended on the grounds that they are implementing Article I, § 27.

3. *Funk v. Wolf*

In *Funk v. Wolf*,[159] the plaintiffs asserted that the ERA imposed an affirmative duty on the Commonwealth to adopt and implement regulations to protect future generations from climate disruption, and that the court should grant mandamus requiring this.[160] The Commonwealth Court, affirmed by the Court, avoided deciding that issue. However, the Commonwealth Court appears to have assumed that prevention of climate disruption falls within the scope of Article 1, § 27's rights and duties and that the Commonwealth had a duty to promulgate regulations "to reduce CO_2 and GHG emissions" pursuant to Pennsylvania Air Pollution Control Act (APCA).[161] The Court further acknowledged that petitioners had a right to submit a rulemaking petition to the Pennsylvania Environmental Quality Board (EQB) seeking the adoption of a specific regulation under the APCA limiting GHG emissions, and that the EQB's action with respect to that petition would be subject to judicial review.[162] The EQB is the Pennsylvania entity that adopts or modifies regulations that are implemented by DEP; DEP does not have authority to adopt its own regulations.[163] As we discuss further in this article, the APCA authorizes the adoption of a regulation establishing an economy-wide cap-and-trade program with allowances distributed by auction with a reserve price. The EQB's refusal to consider such a regulation, or its adoption of an insufficiently protective regulation, could then be subject to judicial review and overturned.

The plaintiffs in *Funk* initially filed a petition with the EQB seeking the adoption of a regulation limiting GHG emissions to prevent undue climate disruption, without proposing a specific regulation or even a specific regulatory approach.[164] Based on DEP's representation that it was already responding to climate disruption, the EQB denied the petition.[165] In fact, DEP's actions were largely token ef-

158. Dernbach, *supra* note 5, at 158-61; *see, e.g.*, Eagle Envtl. II, L.P. v. Commonwealth, Dep't of Envtl. Prot., 584 Pa. 494 (2005).

159. Funk v. Wolf, 144 A.3d 228 (Pa. Commw. Ct. 2016) *aff'd without opinion*, 158 A.3d 642 (Pa. 2017).

160. *Id.* at 232-33.

161. *Id.* at 250.

162. *Id.* at 243.

163. 71 PA. CONS. STAT. §§ 510-20 (2018).

164. Acceptance of Rulemaking Petition for Study, 43 Pa. Bull. 7095 (Dec. 7, 2013); Funk v. Wolf, 144 A.3d 228, 243 (Pa. Commw. Ct. 2016) *aff'd without opinion*, 158 A.3d 642 (Pa. 2017).

165. Acceptance of Recommendation, 44 Pa. Bull. 5679 (Aug. 30, 2014).

forts[166] falling far short of the emissions reductions necessary to prevent climate disruption.[167] Instead of appealing, the plaintiffs brought a mandamus action in the Commonwealth Court against the Commonwealth, the Governor of Pennsylvania, DEP and other agencies. The complaint sought declaratory relief regarding the plaintiffs' rights and the Commonwealth's duties under the ERA.[168] It further sought injunctive relief that would require the Commonwealth to conduct various studies.[169] The complaint also sought a court order requiring DEP to study, and to prepare and implement:

> comprehensive regulations, in accordance with the current science, designed to account for embedded emissions and reduce carbon dioxide and other greenhouse gas emissions to safe levels and thereby reach the concentrations that must be achieved to satisfy [the Commonwealth defendants'] constitutional obligations as public trustees of the air and atmosphere.[170]

The Commonwealth Court held that it had jurisdiction to review the decision.[171] In so holding, it reasoned, *inter alia*, that "we would have appellate jurisdiction over a final order of the EQB denying a rulemaking petition . . . , and a final order of the Environmental Hearing Board (EHB) denying an appeal of a DEP

166. PADEP's report upon which the EQB relied in denying the petition cited a number of actions in the Department's 2009 climate plan that the Department projected would decrease emissions between the base year 2005 and 2020 by under 10 million metric tons, or less than 3.6 percent over a fifteen-year period. *See* PENNSYLVANIA DEP'T OF ENVTL. PROT., RECOMMENDATION TO THE PENNSYLVANIA ENVIRONMENTAL QUALITY BOARD ON THE ASHLEY FUNK PETITION FOR RULEMAKING TO REDUCE CARBON DIOXIDE EMISSIONS 13 (2014) (Figure 1), http://files.dep.state.pa.us/PublicParticipation/Public%20Participation%20Center/PubPartCenterPortalFiles/Environmental%20Quality%20Board/2014/August%2019,%202014%20EQB%20meeting/Ashley%20Funk/1%20-%20DEP%20Recommendation.pdf. While the Paris Agreement calls for reaching climate neutrality by the second half of this century to limit climate disruption, the rate of reduction from the 2009 Plan measures described in the Department's report would not achieve climate neutrality for over four centuries, well into the 25th century. Indeed, the Department concedes that not all of the measures in the 2009 plan had been implemented. *Id.* at 30. That report also cited a number of other actions described in the 2013 climate plan update with no projection of emissions reductions. Many of these actions were federal actions undertaken by the Obama Administration, such as the Clean Power Plan and others constituted measures to reduce increased methane emissions from the shale gas expansion in Pennsylvania. The Petitioner described these reductions as "modest" and "self-congratulatory," "falling short of the Department's 'constitutional obligation.'" *Id.* at 25. The Department's report fails to provide any correlation between the emissions reductions it cites and the goal of keeping temperature increases below 2ºC. *Id.* at 28. In fact, that report specifically rejects the Petitioner's position that emissions should be reduced to zero by 2050. *Id.* at 38.

167. *See* discussion *supra* note 166.

168. Funk v. Wolf, 144 A.3d 228, 237 (Pa. Commw. Ct. 2016), *aff'd without opinion*, 158 A.3d 642 (Pa. 2017).

169. *Id.*

170. *Id.* at 238.

171. *Id.* at 241-43.

decision to not submit a rulemaking petition to the EQB. . . ."[172] The Court also concluded that the plaintiffs had standing to bring the action.[173]

However, the Commonwealth Court ultimately dismissed the action because it found that there was not a sufficiently express mandatory duty that would trigger the remedy of mandamus.[174] The Court's decision was not premised upon an interpretation of Article I, § 27, but on the narrow scope of the remedy of mandamus:

> Mandamus is an extraordinary remedy "designed to compel the performance of a ministerial act or mandatory duty, as opposed to a discretionary act. . . ." Mandamus cannot be used to direct the exercise of judgment or discretion in any particular way. . . . Nor will it issue to establish legal rights. . . . We may issue a writ of mandamus only where the petitioner has a clear legal right to enforce the performance of a ministerial act or mandatory duty, the defendant has a corresponding duty to perform the act[,] and the petitioner has no other adequate or appropriate remedy. . . .[175]

In this regard, the Court found that the question presented in considering a writ of mandamus was not "whether the ERA imposes mandatory duties in the general sense, but whether the ERA provides . . . a clear right to the performance of the specific acts" requested and "whether the[ir] performance . . . is mandatory."[176] The Court reasoned that the remedy of mandamus could not be invoked to expand the authority of executive agencies. It also explained that a judicially enforceable mandatory duty required legislation creating such a mandate, which the Court found lacking.[177]

Although the Court's ultimate decision was premised upon the scope of relief that could be awarded by a court under the narrow equitable writ of mandamus, the decision also relied upon the application of the three-part balancing test that unduly limited the scope of the ERA, and which the *PEDF* Court expressly rejected.[178] Consequently, the Commonwealth Court in *Funk* appears to have overstated the discretion afforded to both the General Assembly and the executive branch and to have understated the scope of the duties imposed by the ERA and the role of the judicial branch in enforcing those duties. It did so by effectively saying that

172. *Id.* at 243.

173. *Id.* at 248.

174. *Id.* at 251-52.

175. *Id.* at 248 (citations omitted).

176. *Id.*

177. *Id.* at 248-50.

178. Pa. Envtl. Def. Found. v. Commonwealth, 161 A.3d 911, 930 (Pa. 2017) (rejecting three-part test because it "strips the constitutional provision of its meaning."); *see* Funk v. Wolf, 144 A.3d 228, 234 (Pa. Commw. Ct. 2016) *aff'd without opinion*, 158 A.3d 642 (Pa. 2017).

compliance with the ERA requires executive agencies only to follow the law prescribed by the General Assembly.[179]

Even under the unduly circumscribed three-part balancing test employed in *Funk*, the decision can be read to support the proposition that there is an enforceable duty to adopt a GHG emission regulation under the APCA, if the regulation is presented to the EQB in a detailed petition. The Commonwealth Court noted that "Respondents further acknowledge that the General Assembly, through the APCA, bestowed upon them a duty to promulgate and implement rules and regulations to reduce CO_2 and GHG emissions."[180]

Consequently, even in applying the unduly constrained test rejected by the Court in *PEDF*, the Commonwealth Court in *Funk* appears to conclude that the ERA creates rights and general duties, that there are specific duties for the EQB to consider a petition with an attached rule, and that there is a duty to adopt regulations addressing climate change under the APCA. The Commonwealth Court noted that if a proposal for a specific rule to address GHG emissions had been submitted to the EQB, the EHB would have had jurisdiction to review the EQB's final action denying the petition and the Commonwealth Court would have had jurisdiction to review the order of the EHB:

> While we agree that we would have appellate jurisdiction over a final order of the EQB denying a rulemaking petition . . . and a final order of the Environmental Hearing Board (EHB) denying an appeal of a DEP decision to not submit a rulemaking petition to the EQB . . . , we would not have appellate jurisdiction over the instant matter.[181]

EQB regulations prescribe a process for filing such a petition with the EQB and the EQB's consideration of the petition.[182] Following any denial of such a petition, a petitioner could bring an action for declaratory and injunctive relief.[183]

179. *See, e.g.*, *Funk*, 144 A.3d at 235 ("[T]he balance between environmental and other societal concerns is primarily struck by the General Assembly, as the elected representatives of the people, through legislative action.").

180. *Id.* at 250. In a footnote, the Court elaborated on the source of this duty, noting that

> the Commonwealth's duties to this end derive, in part, from Section 5(a)(8) of the APCA, 35 PA. CONS. STAT. § 4004(1), which requires the EQB to adopt rules and regulations to implement the federal Clean Air Act, 42 U.S.C. §§ 7401–7671q. The United States Supreme Court, in *Massachusetts v. Envtl. Prot. Agency*, 549 U.S. 497, 528-29 (2007), had "little trouble" concluding that GHGs are "air pollutants" as defined by the Act and that the Environmental Protection Agency may regulate GHGs.

Id. at 250, n.17.

181. *Id.* at 243.

182. *See* 25 PA. CODE §§ 23.1-.8 (2000).

183. *See* Marcellus Shale Coal. v. Dep't of Envtl. Prot., 2016 Pa. Commw. Unpub. LEXIS 830 *62-63; 46 ELR 20179 (Nov. 8, 2016) (granting petition for review in part, in industry's action for declaratory and injunctive relief with respect to newly proposed oil and gas regulations). There would

Consequently, a petitioner could ask the EQB to promulgate a rulemaking to address greenhouse gases, and any denial of such a petition would be subject to judicial review. The Court's analysis in *PEDF* only reinforces the conclusion that the Commonwealth's duty to adopt such a regulation is both mandatory and judicially enforceable.

IV. THE COMMONWEALTH'S DUTY TO PREVENT AND MITIGATE HUMAN-CAUSED CLIMATE DISRUPTION REQUIRES THAT PENNSYLVANIA UNDERTAKE MEASURES TO REDUCE GHG EMISSIONS TO THE LEVEL WARRANTED BY THE SOCIAL COST OF CARBON AND TO ACHIEVE CARBON NEUTRALITY BY MID-CENTURY

Because a stable climate not disrupted by human caused GHG emissions is a right protected under the ERA's first clause and a public natural resource for which the Commonwealth is a trustee, the ERA's text directs that the Commonwealth shall "conserve and maintain" that stable climate for "all the people, including generations yet to come."[184] Neither the text of the ERA nor the law of trusts provides additional guidance on concentrations of GHGs in the atmosphere that will conserve the climate, the trajectory of emissions reductions necessary to avoid exceeding that concentration, or Pennsylvania's responsibility *vis-à-vis* the rest of the world. Pennsylvania's contribution to GHG emissions exceeds that of most nations.[185] If states were counted as nations, Pennsylvania would have ranked as the sixteenth highest emitter in 2003.[186] Nevertheless, its actions alone will be insufficient to "conserve and maintain" the climate.[187]

be no adequate remedy requiring such a petitioner to wait for PADEP to take some action that would be appealable to the Environmental Hearing Board. *See* Arsenal Coal Co. v. Commonwealth, 505 Pa. 198, 209-10 (1984) (Commonwealth Court erred in declining to exercise equitable jurisdiction over industry's petition to enjoin the Department of Environmental Resources from implementing or enforcing regulations promulgated by the EQB, where the internal administrative process would subject the industry to litigation and regulatory uncertainty). *A fortiori*, if there is no adequate remedy for an industry that must undertake litigation and experience regulatory uncertainty during a post-enforcement proceeding by PADEP, there is no adequate remedy for a petitioner seeking a rulemaking to address GHG emissions that is never even promulgated in the first place.

184. PA. CONST. art. I, § 27.

185. *See* Robert B. McKinstry, Jr., Adam Rose, & Coreen Ripp, *Incentive-Based Approaches to Greenhouse Gas Mitigation in Pennsylvania: Protecting the Environment and Promoting Fiscal Reform*, 14 WIDENER L.J. 205, 217 (2004) (citation omitted).

186. *Id.*

187. Pennsylvania's gross GHG emissions in 2013 totaled 305.75 million metric tons. *See* PA. DEP'T OF ENVTL. PROT., PENNSYLVANIA GREENHOUSE GAS INVENTORY 2016 4 (2016), http://files.dep.state.pa.us/Air/AirQuality/AQPortalFiles/Advisory%20Committees/CCAC/Docs/Inventory-2016_1-18-17_(final).pdf. *See also* Massachusetts v. Envtl. Prot. Agency, 549 U.S. 497, 524-25 (2007). The Supreme Court rejected EPA's argument that regulation of automobile emissions in the United States, which then totaled 1.7 billion metric tons of carbon dioxide and represented "more than 6% of worldwide carbon dioxide emissions" would fail to meet the "causation" element of standing. The

Finally, the ERA does not tell us how Pennsylvania should exercise its duty to prevent climate disruption. At a minimum, one might argue that the constitutional standard requires Pennsylvania to do as much as it can, using existing authority. One can look to other sources of authority defining what is required to "conserve and maintain" a stable climate, Pennsylvania's share of responsibility, and the means that can be employed. Specifically, as we discuss below, binding treaty law and other federal law define the temperature and concentration goals and Pennsylvania's share. As recognized by the *Funk* decision, the APCA provides available tools for limiting emissions.[188] Those tools can be defined in a properly framed regulation presented by way of a petition to the EQB.[189] The EQB's action on that petition can be subject to judicial review under the equitable writ of *certiorari* rather than *mandamus*.[190] As further described below, whether framed as the "as much as it can" standard or a standard incorporating these other sources of authority, at a minimum the mechanism should include a trading program that reduces emissions to the level warranted by the social cost of carbon and ultimately to achieve carbon neutrality by mid-century.

A. *The United Nations Framework Convention on Climate Change and the Federal Clean Air Act Provide Judicially Ascertainable Standards Governing the Extent of Reductions Required to Conserve and Maintain a Stable Climate and Pennsylvania's Relative Responsibility*

A judicially ascertainable standard for determining the emissions reductions required to conserve and maintain the climate is provided by an international treaty ratified by the United States, the United Nations Framework Convention on Climate Change (UNFCCC),[191] the Paris Agreement[192] adopted pursuant to that

Court reasoned that the fact "[t]hat a first step might be tentative does not by itself support the notion that federal courts lack jurisdiction to determine whether that step conforms to law." The Court further reasoned that "[j]udged by any standard, U.S. motor-vehicle emissions make a meaningful contribution to greenhouse gas concentrations and hence, according to petitioners, to global warming." *Id.* at 525.

188. Funk v. Wolf, 144 A.3d 228, 250 n.17 (Pa. Commw. Ct. 2016), *aff'd without opinion*, 158 A.3d 642 (Pa. 2017).

189. 25 PA. CODE § 23.1.

190. *Funk*, 144 A.3d at 242-43.

191. United Nations Framework Convention on Climate Change, June 4, 1992, 1771 U.N.T.S. 107, http://unfccc.int/files/essential_background/background_publications_htmlpdf/application/pdf/conveng.pdf. (providing a general framework for the international reduction of GHG emissions).

192. United Nations Framework Convention on Climate Change, *The Paris Agreement*, Dec. 12, 2015, http://unfccc.int/paris_agreement/items/9485.php [hereinafter *The Paris Agreement*]. President Trump announced his intent to withdraw the United States from the Paris Agreement. Donald J. Trump, *Statement by President Trump on the Paris Climate Accord*., THE WHITE HOUSE (June 1, 2017), https://www.whitehouse.gov/briefings-statements/statement-president-trump-paris-climate-accord/. However, that announcement will be ineffective with respect to Pennsylvania's interpretation of the ERA and likely will also be ineffective with respect to federal law. First, no withdrawal can take effect until November 2020, because parties are not entitled to withdraw until three years after the Agreement

Convention, and the body of internationally-accepted scientific evidence endorsed by the nations of the world pursuant to the UNFCCC and the Paris Agreement. Pennsylvania's share of the reductions is governed by the federal Clean Air Act.[193] Under the Supremacy Clause of the United States Constitution, Pennsylvania is bound to interpret its constitution consistent with treaties which, along with the United States Constitution and federal laws, constitute the "supreme Law of the Land" that binds state courts.[194]

The objective of the UNFCCC is the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."[195] While the Convention does not further identify what that level is, the 2015 Paris Agreement does.[196] In the run-up to the

entered into force and withdrawal does not take effect until one year after the withdrawal. *The Paris Agreement*, art. 28. Second, the Paris Agreement merely interprets the UNFCCC, from which the United States has not withdrawn, and which remains therefore binding law under Article III of the Constitution. Finally, the pertinent requirements of the UNFCCC as interpreted by the UNFCCC are likely now customary international law that will be binding on the United States and its states notwithstanding the United States' withdrawal. Robert B. McKinstry, Jr., Thomas D. Peterson & Steven Chester, *Unlocking Willpower Part Two*, 47 ENVTL. L. REP. 10135, 10137-38 (2017); *see also* Robert B. McKinstry, Jr., *What Really Happened? Implications of President Trump's Announcement on U.S. Withdrawal From the Paris Agreement and the Law of Unintended Consequences,* BALLARD SPAHR (July 2017) at 1-2, https://response.ballardspahr.com/email_handler.aspx?sid=5427bed1-f563-45e1-8cb1-74758039dace&redirect=http%3a%2f%2fwww.ballardspahr.com%2f%7e%2fmedia%2fFiles%2fArticles%2fWhat_Really_Happened (It is important to note that even if the Paris Agreement's definition of the intent of the UNFCCC to prevent "dangerous anthropogenic interference with the climate system" should not be considered binding law, the international scientific consensus reflected in the Paris Agreement can equally define the emissions reductions required to fulfill the Commonwealth's duty as a trustee to conserve and maintain a stable climate.).

193. *See generally* Clean Air Act, 42 U.S.C. §§ 7401-7671 (2012).

194. *See* U.S. CONST. art. VI, cl.2. The *Charming Betsy* doctrine, requiring that federal law be construed consistent with the "law of nations," should be equally binding with respect to the interpretation of state constitutional law. Murray v. Schooner Charming Betsy, 6 U.S. 64, 118 (1804).

195. UNFCCC, *supra* note 191, art. 2.

196. *The Paris Agreement*, *supra* note 192, art. 2, § 1.

> This Agreement, in enhancing the implementation of the Convention, including its objective, aims to strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty, including by: . . .(a) Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change.

Id. See also id. art. 4 § 1.

> In order to achieve the long-term temperature goal set out in Article 2, Parties aim to reach global peaking of greenhouse gas emissions as soon as possible, recognizing that peaking will take longer for developing country Parties, and to undertake rapid reductions thereafter in accordance with best available science, so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century.

Id.

Paris Conference, the Conference of the Parties translated the Framework Convention's stabilization objective into a maximum permissible surface temperature increase. The most frequently stated goal was 2°C (or 3.6° F) above pre-industrial levels.[197] Reflecting the evolving scientific consensus on the temperature rise at which serious climate disruption will occur, the Paris Agreement aims to hold "the increase in the global average temperature to well below 2°C above pre-industrial levels."[198] The parties also agreed "to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change."[199]

Also reflecting the scientific consensus of the nations of the world, the Paris Agreement further defines the emissions reductions required to keep temperatures below those thresholds by requiring that the Parties "achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century."[200] If the entire world needs to reach a point where emissions of GHGs are no greater than their removal by GHG sinks by the second half of this century, Pennsylvania will also need to achieve that balance by that time. Therefore, at a minimum, Pennsylvania must develop an emissions reduction trajectory that reduces net emissions to zero, meaning the elimination of all GHG emissions other than those geologically or biologically returned to sinks (*i.e.* sequestered) by the second half of the 21st century. Because Pennsylvania's GHG emissions are disproportionately higher than most of the rest of the world, Pennsylvania should achieve that goal by mid-century.

This goal furthers the UNFCCC requirement that the developed nations take the lead in reducing emissions, enacting policies to limit emissions, and enhance carbon sinks.[201] These policies are to be precautionary, comprehensive and "cost-effective so as to ensure global benefits at the lowest possible cost . . . and comprise all economic sectors."[202] There is a scientific consensus, reflected in a growing

197. *See, e.g.*, United Nations Framework Convention on Climate Change, *Report of the Conference of the Parties on its Sixteenth Session, Held in Cancun from 29 November to 10 December 2010*, ¶ 4, U.N. Doc. 1/CP.16, FCCC/CP/2010/7/Add.1 (Mar. 15, 2011), http://unfccc.int/resource/docs/2010/cop16/eng/07a01.pdf.

198. United Nations Framework Convention on Climate Change, *Conference of the Parties*, Decision 1/CP.21, art. 2.1(a), U.N. Doc. FCCC/CP/2015/L.9/Rev.1 (2015), https://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf.

199. *Id.*

200. *Id.* art. 4, § 1.

201. UNFCCC, *supra* note 191, art. 3, § 1; art. 3 § 3; art. 4, § 2(a); *The Paris Agreement*, *supra*, note 192, art. 4, § 4.

202. UNFCCC, *supra* note 191, art. 3, § 3; *see The Paris Agreement*, *supra* note 192, art. 4, § 4 (requiring the United States and other developed country parties to take the lead in achieving the necessary reductions); UNFCCC, *supra* note 191, art. 4, § 2(a)(calling for the adoption of "policies and take corresponding measures on the mitigation of climate change, by limiting its anthropogenic emissions of greenhouse gases and protecting and enhancing its greenhouse gas sinks and reservoirs"); UNFCCC, *supra* note 191, art. 3, § 2 (requiring each nation to consider impacts beyond those within its borders,

number of state and local emissions reduction goals, that developed nations need to reduce their total economy-wide emissions by at least 80% from 1990 levels by 2050.[203] Moreover, a growing number of studies, including a study by the World Bank, have concluded that this goal is achievable.[204]

The provisions of the federal Clean Air Act governing the obligations of states support the proposition that Pennsylvania should consider these treaty obligations in construing its obligations as a trustee under Article I, § 27. Section 115 of the Clean Air Act is triggered whenever the EPA finds air pollution originating within a state "cause[s] or contribute[s] to air pollution which may reasonably be anticipated to endanger public health or welfare in a foreign country."[205] When that happens, the EPA must require the state to submit an amendment to the "good neighbor" provision of its state implementation plan[206] that will "prevent or eliminate the endangerment."[207] In its endangerment finding, EPA found that emissions of GHGs within the United States endanger health and the environment in other nations.[208] Virtually all other nations of the world are parties to the

considering "the specific needs and special circumstances of developing country Parties, especially those that are particularly vulnerable to the adverse effects of climate change").

203. Cal. Exec. Order No. B-30-15 (Apr. 29, 2015), https://www.gov.ca.gov/2015/04/29/news18938/; Conn. Exec. Order No. 46 P1 (2015); Colo. Exec. Order No. D 004 08 § 1 (Apr. 22, 2008); MASS. GEN. LAWS ch. 21N, § 3(b)(4); Mich. Exec. Dir. 2009-4 Section II; 2015 Minn. Laws 216H.02 subd 1; N.J. STAT. ANN. § 26:2C-38 (West 2009); N.Y. Exec. Order No. 24 (2009), https://www.dec.ny.gov/energy/71394.html; 42 R.I. GEN. LAWS § 42-6.2-2(a)(C) (2014).

204. MARIANNE FAY ET AL., INT'L BANK FOR RECONSTRUCTION AND DEV./THE WORLD BANK, DECARBONIZING DEVELOPMENT: THREE STEPS TO A ZERO-CARBON FUTURE 96 (2015), http://www.worldbank.org/content/dam/Worldbank/document/Climate/dd/decarbonizing-development-report.pdf; JEFFREY SACH, ET AL., SUSTAINABLE DEVELOPMENT SOLUTIONS NETWORK AND THE INST. FOR SUSTAINABLE DEV. AND INT'L RELATIONS, PATHWAYS TO DEEP DECARBONIZATION IX (Emmanuel Guérin, et al. eds. 2014), http://unsdsn.org/wp-content/uploads/2014/09/DDPP_Digit_updated.pdf; *see also* John C. Dernbach, *Creating Legal Pathways to a Zero Carbon Future*, *in* CONTEMPORARY ISSUES IN CLIMATE CHANGE LAW AND POLICY: ESSAYS INSPIRED BY THE IPCC 21 (Robin Kundis Craig & Stephen R. Miller eds. 2016).

Because the endpoint will be carbon neutrality, this will be required of Pennsylvania under any scenario.

205. 42 U.S.C. § 7415(a) (2016).

206. 42 U.S.C. § 7410(a)(2)(H)(ii) (2016).

207. *Id.* § 7415(b) (2015).

208. Endangerment Finding, *supra* note 82, at 66,514 (The EPA made the finding in connection with its determination that the impacts of climate change in foreign nations would, in turn, endanger health and welfare within the United States:

> EPA is not considering international effects to determine whether the health and welfare of the public in a foreign country is endangered. Instead, EPA's consideration of international effects for purposes of determining endangerment is limited to how those international effects impact the health and welfare of the U.S. population);

Id. The precise nature of the Administrator's finding regarding international effects is set forth in the proposed finding, which the Administrator adopted in the final action:

UNFCCC and the Paris Agreement, which provides the United States reciprocal rights with respect to the prevention and control of greenhouse gases.[209] These facts trigger the obligation to reduce GHG emissions to prevent endangerment in

> On a global basis, according to the IPCC, projected climate change-related impacts are likely to affect the health of millions of people, particularly those with low adaptive capacity, as a result of a number of factors including increased cardio respiratory diseases due to higher concentrations of groundlevel ozone brought on by higher temperatures, and by more frequent and intense heat waves. Food production is expected to be much more vulnerable to climate change in poorer regions of the world compared to food production in the U.S. The IPCC also identified that the coasts around the world are experiencing the adverse consequences of hazards related to climate and sea level. Coastal settlements are highly vulnerable to extreme events, such as storms which impose substantial costs on coastal societies. Ecosystems and species around the world are very likely to show a wide range of vulnerabilities to climate change, depending on the extent to which climate change alters conditions that could cross critical thresholds. The most vulnerable ecosystems include coral reefs, sea-ice ecosystems, high-latitude boreal forests, and mountain ecosystems where there is no possibility of migrating to adapt to climate change.
>
> Climate change impacts in certain regions of the world may exacerbate problems that raise humanitarian, trade and national security issues for the U.S. Climate change has been described as a potential threat multiplier regarding national security issues. This is because, as noted above, climate change can aggravate existing problems in certain regions of the world such as poverty, social tensions, general environmental degradation, and conflict over increasingly scarce water resources.

Proposed Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act, 74 Fed. Reg. 18886, 18903 (Apr. 24, 2009). Although the Administrator stated that she was not making a foreign endangerment finding, these factual determinations regarding effects in foreign nations underlying her determination that these effects would cause endangerment in the United States effectively constitute a finding that GHG emissions in the United States cause or contribute to endangerment in other nations.

209. *See Status of Ratification of the Convention*, UNITED NATIONS, https://unfccc.int/process/the-convention/what-is-the-convention/status-of-ratification-of-the-convention (196 nations and 1 regional economic integration organization are Parties) (last visited Apr. 17, 2018); *UNFCCC Status as of 17-04-2018*, UNITED NATIONS TREATY COLLECTION, https://treaties.un.org/Pages/ViewDetailsIII.aspx?src=IND&mtdsg_no=XXVII-7&chapter=27&Temp=mtdsg3&clang=_en (last visited July 9, 2018); *Paris Agreement – Status of Ratification*, UNITED NATIONS, https://unfccc.int/process/the-paris-agreement/status-of-ratification (175 Parties have ratified of 197 Parties to the Convention) (last visited Apr. 17, 2018); *Paris Agreement Status as at 17-04-2018*, UNITED NATIONS TREATY COLLECTION, https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-7-d&chapter=27&clang=_en (last visited July 4, 2018). *See The Paris Agreement* art. 2 § 1 (a), art. 3, art. 4 § 1 (Article 3 of the Paris Agreement calls for all Parties "to undertake and communicate ambitious efforts" as defined further in the Agreement "with the view to achieving the purpose of the Agreement as set out in Article 2," viz. limiting GHG emissions to hold "the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels" by achieving net emissions neutrality by the second half of the century. Thus, there are reciprocal rights and obligations to reduce emissions among the 175 parties to the Agreement.). *See generally* Michael Burger et. al., *Legal Pathways to Reducing Greenhouse Gas Emissions Under Section 115 of the Clean Air Act*, UCLA School of Law, Public Law Research Paper No. 16-11 (Jan. 2016), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2742366.

other nations within the meaning of section 115.[210] Further, the Clean Air Act's good neighbor provision requires that each state implementation plan include "adequate provisions . . . insuring compliance with the requirements of section . . . [115] of this title (relating to . . . international air pollution)."[211] Although EPA has not issued a call for states to submit state implementation plans (SIPs) to reduce GHG emissions under section 115, the predicates triggering the mandatory obligation to do so exist. Thus, Pennsylvania's obligations under the Clean Air Act's good neighbor provision also exist. These create an obligation for Pennsylvania, as a fiduciary under the ERA, to take action to reduce emissions to prevent endangerment of foreign nations from GHG pollution consistent with the good neighbor provision.

B. *Pennsylvania's Obligation as a Trustee Should Require that GHG Emissions Be Limited to the Extent Consistent with the Social Cost of Carbon and to Achieve Carbon Neutrality by Mid-Century*

A regulatory program that is designed to take all measures reasonably necessary to conserve the corpus of the environmental trust resource for the benefit of the trust's beneficiaries will most closely hew to the intent and text of the ERA as interpreted in *PEDF* and the *Robinson Township* plurality. That program should therefore employ all measures reasonably necessary to conserve a stable climate and the public environmental resources it supports. As explained further below, this can be best accomplished by putting a price on emissions of GHGs at least equal to the social cost of carbon and by recovering the value of that emissions price as income for the beneficiaries of the trust. We will explain below the derivation of this "social cost of carbon" and its relevance to Pennsylvania's constitutional obligations as a trustee under the ERA.

1. The Relationship of the Social Cost of Carbon to Pennsylvania's Obligations as a Trustee

In economic theory, the impacts of climate disruption represent "externalities" of the emissions of GHGs that are not reflected in the market price of the products whose manufacture produces those emissions.[212] Under that theory, those who emit GHGs are appropriating the resources they damage without paying for the damage. Principles of economic efficiency, as well as equity, require that those responsible for the damage pay for it and that the damage be reflected in the price of the

210. *See* Her Majesty the Queen in Right of Ontario v. Envtl. Prot. Agency, 912 F.2d 1525, 1528 (D.C. Cir. 1990); *see also* McKinstry, Peterson & Chester, *supra* note 192, at 10142.

211. 42 U.S.C. § 7410(a)(2)(D)(ii) (2012).

212. NAT'L RESEARCH COUNCIL, HIDDEN COSTS OF ENERGY: UNPRICED CONSEQUENCES OF ENERGY PRODUCTION AND USE 28-29 (2010).

goods whose manufacture will cause the damage. If the cost of reducing emissions is less than the cost of the damages avoided, the emitter will reduce the emissions, creating a net increase in social welfare; the market will therefore favor activities that do not emit the GHGs that cause the damage.[213] The social cost of carbon is a measure of the future estimated cost or damage resulting from the emission of a metric ton of carbon today; imposing that cost on carbon emissions today will shift economic activity to other activities that do not result in that cost or damage.[214]

There have been a number of efforts to calculate this social cost of carbon. Because a series of Executive Orders required that federal agencies prepare cost-benefit analyses to assess the impact of regulatory actions, the United States convened an interagency task force to determine this social cost of carbon, producing reports in 2010 and 2016.[215] Based on updated data on the damages caused by climate disruption, the 2016 report calculated a variety of values representing the average and high cost of GHG emissions for different time periods and discount rates.[216] As action is delayed, the social cost of carbon increases because the damage

213. *Id.* at 32; *see* McKinstry, Rose, & Ripp, *supra* note 185, at 214-221; *see also* SAMUEL A. NEWELL ET AL., N.Y. DEP'T. OF PUB. SERV., N.Y. INDEP. SYS. OPERATOR, PRICING CARBON INTO NYISO'S WHOLESALE ENERGY MARKET TO SUPPORT NEW YORK'S DECARBONIZATION GOALS 3 (2017), https://www.energymarketers.com/Documents/Brattle_study_carbon_pricing.pdf.

214. NAT'L RESEARCH COUNCIL, *supra* note 212, at 60.

215. *See* Regulatory Planning & Review, 58 Fed. Reg. 51,735 (Sept. 30, 1993) (requiring agencies, to the extent permitted by law, "to assess both the costs and the benefits of the intended regulation and, recognizing that some costs and benefits are difficult to quantify, propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs"); INTERAGENCY WORKING GRP. ON SOC. COST OF CARBON, TECHNICAL SUPPORT DOCUMENT: SOCIAL COST OF CARBON FOR REGULATORY IMPACT ANALYSIS UNDER EXECUTIVE ORDER 12866 (2010), https://19january2017snapshot.epa.gov/sites/production/files/2016-12/documents/scc_tsd_2010.pdf; INTERAGENCY WORKING GRP. ON SOC. COST OF GREENHOUSE GASES, TECHNICAL SUPPORT DOCUMENT: TECHNICAL UPDATE OF THE SOCIAL COST OF CARBON FOR REGULATORY IMPACT ANALYSIS UNDER EXECUTIVE ORDER 12866 (2016), https://19january2017snapshot.epa.gov/sites/production/files/2016-12/documents/sc_co2_tsd_august_2016.pdf [hereinafter 2016 SCC]; INTERAGENCY WORKING GRP. ON SOC. COST OF GREENHOUSE GASES, ADDENDUM TO TECHNICAL SUPPORT DOCUMENT ON SOCIAL COST OF CARBON FOR REGULATORY IMPACT ANALYSIS UNDER EXECUTIVE ORDER 12866: APPLICATION OF THE METHODOLOGY TO ESTIMATE THE SOCIAL COST OF METHANE AND THE SOCIAL COST OF NITROUS OXIDE (2016), https://19january2017snapshot.epa.gov/sites/production/files/2016-12/documents/addendum_to_sc-ghg_tsd_august_2016.pdf. *See* Presidential Order on Promoting Energy Independence and Economic Growth, 82 Fed. Reg. 16,093 (Mar. 31, 2017). President Trump has issued an Executive Order directing the withdrawal of the social cost of carbon guidance. However, that Order has no binding legal effect standing alone and there are cogent reasons to believe that, if it were applied, that application would not withstand judicial review. The guidance represented the peer-reviewed consensus of a group of scientific and economic experts. The conclusions can no more be undone by unilateral executive fiat than can the conclusions of any other expert report.

216. 2016 SCC, *supra* note 215, at 4.

is greater, more imminent, discounted less.[217] The 2016 report calculated that the average social cost of carbon in 2020 (using a discount rate of 3%) is $42/ton, but that the 95th percentile (high) cost would be $123/ton. In 2050, these figures increase to $69/ton and $212/ton.[218] These costs represent the marginal cost of avoiding future damage from the emission of a ton of carbon in any given year and they, therefore, do not include the damage that will already occur as a result of past emissions.[219]

Federal agencies, states, and federal courts have relied upon the social cost of carbon in determining which measures should be employed to prevent GHG emissions. Prior to 2017, federal agencies routinely relied upon the social cost of carbon developed by the expert panel in cost-benefit analyses.[220] The Seventh Circuit spe-

217. *See* ENVTL. PROT. AGENCY, FACT SHEET, SOCIAL COST OF CARBON 2 (2016), https://19january2017snapshot.epa.gov/sites/production/files/2016-12/documents/social_cost_of_carbon_fact_sheet.pdf [hereinafter EPA SCC FACT SHEET].

218. 2016 SCC, *supra* note 215, at 4, Table ES-1.

Bob Litterman, one of the world's leading economists on pricing risk suggests that the failure of the calculations of the social cost of carbon to incorporate high damage-low probability events results in a lower cost estimates and emphasizes that delay in mitigation by fifteen years will triple the social cost of carbon. Bob Litterman, Kent Daniel & Gernot Wagner, Applying Asset Pricing Theory to Calibrate the Price of Climate Risk 43 (Mar. 15, 2017), https://globalriskinstitute.org/wp-content/uploads/2017/05/GRI_Asset-Pricing-Climate-Risk_Mar-15-2017-Litterman.pdf.

219. EPA SCC FACT SHEET, *supra* note 217, at 1 ("The SC-CO2 is a measure, in dollars, of the long-term damage done by a ton of carbon dioxide (CO2) emissions in a given year. This dollar figure also represents the value of damages avoided for a small emission reduction (*i.e.*, the benefit of a CO2 reduction).")

220. For example, the EPA SCC Fact Sheet that accompanied the release of the 2016 SCC gave the following examples of EPA's use of the SCC in rulemakings:

> EPA has used the interagency group recommended estimates of the SC-CO2 to analyze the carbon dioxide impacts of various rulemakings since 2010. Examples of these rulemakings include:
>
> - The Joint EPA/Department of Transportation Rulemaking to establish Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards (2012-2016)
> - Amendments to the National Emission Standards for Hazardous Air Pollutants and New Source Performance Standards (NSPS) for the Portland Cement Manufacturing Industry
> - Regulatory Impact Results for the Reconsideration Proposal for National Emission Standards for Hazardous Air Pollutants for Industrial, Commercial, and Institutional Boilers and Process Heaters at Major Sources
> - Proposed National Emission Standards for Hazardous Air Pollutants (NESHAP) for Mercury Emissions from Mercury Cell Chlor Alkali Plants
> - Standards of Performance for New Stationary Sources and Emission Guidelines for Existing Sources: Commercial and Industrial Solid Waste Incineration Units Standards
> - Final Mercury and Air Toxics Standards

cifically approved this use of that social cost of carbon in promulgating energy efficiency regulations in *Zero Zone v. Department of Energy*.[221] Both Illinois and New York relied upon the federally-determined social cost of carbon in the development of zero emissions credit (ZEC) programs to "encourage the preservation of the environmental values or attributes of zero-emissions nuclear-powered electric generating facilities for the benefit of the electric system, its customers and environment."[222] These programs provide assurances that the electricity generators will receive value equivalent to the avoided cost of carbon emissions calculated using the federal social cost of carbon.[223] Federal district courts have rejected a variety of challenges to both state programs.[224]

Although President Trump has issued an Executive Order withdrawing the federal social cost of carbon,[225] that action should not preclude state reliance on the expert determinations underlying that metric. It is also doubtful that the President can reverse the determination of a panel of scientific experts by administrative fiat, particularly where regulations based on the scientific determination have been upheld on judicial review and the derivation of the metric is consistent with principles of international law.[226]

- Joint EPA/Department of Transportation Rulemaking to establish Medium- and Heavy- Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards
- Proposed Carbon Pollution Standard for Future Power Plants
- Joint EPA/Department of Transportation Rulemaking to establish 2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards.

EPA SCC FACT SHEET, supra note 217, at 4-5.

221. Zero Zone v. Dep't of Energy, 832 F.3d 654, 677 (7th Cir. 2016).

222. Coal. for Competitive Elec. v. Zibelman, 272 F. Supp. 3d 554, 561 (S.D.N.Y. 2017), *appeal filed* (2d Cir. Aug. 25, 2017) (quoting CES Order, app. E, at 1).

223. *Id.* at 562. Specifically, "the price of each ZEC is the social cost of carbon less the generator's putative value of avoided greenhouse gas emissions less the amount of the forecast energy price." *Id.*

224. Vill. of Old Mill Creek v. Star, 2017 WL 3008289, No. 17 CV 1163 and 1164 (N.D. Ill. July 14, 2017) (upholding Illinois program); *Zibelman*, 272 F. Supp. at 561 (upholding New York program). Although both programs are under appeal, the use of the federal social cost of carbon is not an issue in those appeals.

225. *See* Exec. Order No. 13,783, 82 Fed. Reg. 16,093 (Mar. 31, 2017).

226. The action is reminiscent of the apocryphal story of King Canute's attempt to hold back the tides cited in *Diamond v. Chakrabarty*, 447 U.S. 303, 317 (1980). The Regulatory Impact Statement supporting EPA's proposal to withdraw the Clean Power Plan uses a much lower social cost of carbon based on a limitation of consideration of damages to those that will occur only within the United States. This appears to be directly contrary to the UNFCCC's principle applicable to all parties set forth in Article 3, Section 3 directing that rules "should be cost-effective so as to ensure global benefits at the lowest possible cost." In other words, cost-effectiveness should consider global benefits in the form of reduced global damages rather than limiting that consideration to the benefits accruing to an individual nation or, in the case of Pennsylvania, state.

The social cost of carbon has several implications with respect to the Commonwealth's duties as a trustee under the reasoning of *Robinson Township* and *PEDF*. First, allowing emissions to continue unabated will increase the damage to the corpus of the trust.[227] If a price is put on the emissions equal to the social cost of carbon, or emitters are otherwise required to implement all emissions reductions up to that cost, the damage to the corpus of the trust will be avoided consistent with the duty to "conserve and maintain" the trust corpus. Second, the social cost of carbon provides a way of measuring the cost of damage from climate change, including damage to public natural resources, through state actions allowing unregulated emissions of GHGs. Third, the Commonwealth's duty to "act affirmatively via legislative action to protect the environment,"[228] suggests that the state could use a mechanism like the social cost of carbon to constrain the emissions of GHGs that harm public natural resources. This result seems compelled by the text of the ERA and the trustee's duty of prudence as found by the Court in *PEDF*.[229]

While the social cost of carbon is based on the marginal cost of greenhouse gas emissions based on global damages, the ERA relates to the public natural resources of the Commonwealth of Pennsylvania. The most relevant public natural resource, a stable climate not disrupted by human GHG pollution, is both a global resource and a Pennsylvania public resource. If a cost is put on GHG emissions, as contemplated by the derivation of the social cost of carbon, parties will implement all control measures that cost less than the social cost of carbon, so that the social cost of carbon represents the cost that should be imposed to prevent "unreasonable degradation of natural resources."[230] A lower cost will be insufficient to conserve the global resource, and if the global climate is disrupted, Pennsylvania's climate will be equally disrupted.[231] Because GHGs are global pollutants, if Pennsylvania does not implement all measures costing less than the social cost of carbon, but instead uses some lesser value based on the damage within Pennsylvania itself, the global climate will be disrupted, and Pennsylvania trust resources will neither be conserved nor maintained.

There is a second legal reason for employing a measure based on the marginal global cost associated with a ton of GHGs. The UNFCCC requires that developed

227. *See supra* Section III.A.

228. Robinson Twp. v. Commonwealth, 83 A.3d 901, 958 (Pa. 2013) (plurality); Pa. Envtl. Def. Found. v. Commonwealth, 161 A.3d 911, 933 (Pa. 2017).

229. *See PEDF*, 161 A.3d at 932 (citation omitted); *see also id*. at 938 (invalidating transfer of funds because it violated the duty of prudence and the duty to use trust assets in accordance with the trust purposes). Whether the Commonwealth's failure as a trustee to preserve the corpus of the trust resources after damage may have created liability for damage is beyond the scope of this article.

230. *See Robinson Twp.*, 83 A.3d at 953 (quoting Mont. Envt'l Info. Ctr. v. Dep't of Envtl. Quality, 988 P.2d 1236, 1249 (1999)).

231. An argument premised on the proposition that one should ignore the global marginal cost of the emissions of a ton of GHGs in calculating the social cost of carbon would be the equivalent of arguing that one should ignore global demand and cost considerations in valuing the price of oil.

nations implement policies and measures to deal with climate change that "should be cost-effective so as to ensure global benefits at the lowest possible cost."[232] In this case, the "global benefits" are the avoided global damages measured by the social cost of carbon. For this reason, the social cost of carbon appears to be the best measure to determine both the value of the undisrupted climate resources and the scope of measures required under the ERA to prevent unreasonable degradation of those resources.

2. Support for a Meaningful Price on GHG Emissions

The APCA authorizes the EQB to adopt a regulation putting a price on GHG emissions commensurate with the social cost of carbon and establishing a descending cap that achieves carbon neutrality by mid-century. The *PEDF* decision provides additional support for such a regulation through two overlapping rationales. First, there is a significant argument that allowing private parties to emit GHGs is the equivalent of allowing them to appropriate ecosystem services for free even though the Commonwealth has a fiduciary duty to assure that the beneficiaries of the trust obtain a fair price. Allowing the use of these resources without requiring payment would arguably loot public trust resources in an even more egregious way that the General Assembly's looting in *PEDF*. Second, putting a price on emissions commensurate with the social cost of carbon and establishing a descending cap that achieves carbon neutrality by mid-century is necessary to sufficiently maintain and conserve the ERA trust resources.[233] Both rationales would support either the imposition of a fee or capping emissions and auctioning allowances with a reserve price that is adequate both to (1) assure the conservation of the trust resources by limiting the risk to those resources and (2) compensate the Commonwealth for the damage to public resources that will occur. In either case, the required price would be at least as great as the social cost of carbon, which, as discussed above, is based on the marginal cost of the future damage avoided by each ton of carbon dioxide emitted.[234]

Putting a price on carbon consistent with the social cost of carbon under each of the foregoing rationales is arguably mandated by the fiduciary duties cited by the Court in *PEDF*. These duties include the duty of prudence, which "requires a trustee to 'exercise such care and skill as a man of ordinary prudence would exercise in dealing with his own property.'"[235] A prudent trustee would seek to use an

232. UNFCCC, *supra* note 191, art. 3, § 3.

233. Because, as discussed above, the social cost of carbon should be set at a level reflecting the damages avoided by not emitting an additional ton of carbon dioxide, with a premium reflecting the risk of catastrophic results and uncertainty, emissions will be avoided as long as the value from emitting the carbon dioxide is greater than the damage with the risk premium.

234. *See* EPA SCC FACT SHEET, *supra* note 217, at 1.

235. *PEDF*, 161 A.3d at 932 (quoting *In re* Mendenhall, 398 A.2d 951, 953 (Pa. 1979) (quoting RESTATEMENT (SECOND) OF TRUSTS § 174).); *see also id.* at 938.

effective means of protecting the trust corpus; the effectiveness of a carbon price for this purpose is supported by both theory and experience. Putting this price on carbon emissions is also consistent with the text of the ERA, which directs the Commonwealth, as trustee, to "conserve and maintain" the trust corpus in furtherance of the people's enumerated rights. Requiring polluters to purchase at auction their right to pollute the air, subject to a reserve price equal to the avoided damage as represented by the social cost of carbon, is more consistent with the Commonwealth's duties as a trustee for its natural resources than allowing those polluters to appropriate those public resources free of charge and, as a result, deplete or damage the corpus of the trust.

V. A REGULATORY STRUCTURE AUTHORIZED BY EXISTING LAW CAN ACHIEVE CARBON NEUTRALITY BY MID-CENTURY AND IMPOSE THE SOCIAL COST OF CARBON ON GHG EMISSIONS

As suggested by *Funk v. Wolf*,[236] individuals adversely affected by climate disruption could assert their right under Article I, § 27 to have the Commonwealth perform its duty as a trustee to prevent climate disruption by submitting a petition to the EQB seeking the promulgation of specific regulations limiting GHG emissions pursuant to the APCA.[237] The petition must include a proposed regulation or regulatory structure consistent with existing statutory authority.[238] That authority would need to support a court order compelling the regulation's adoption should the EQB fail to act, and withstand judicial review if the regulation were adopted by the EQB. To accomplish this, the structure should satisfy the following criteria:

- First, as discussed above, the regulatory structure should result in the reduction of emissions sufficient to achieve net carbon neutrality by the second half of the century, if not earlier.
- Second, as also discussed above, the regulatory structure should either impose a cost on emissions equal to the social cost of carbon or require all emissions reduction measures less than that cost. The structure could start with a lower cost that grows steadily over time, creating consistency with other programs, generating a predictable framework for investment decisions and facilitating a transition from free emissions to emissions that incur a cost.
- Third, as also discussed above, the structure should generate income for the beneficiaries of the trust without impairing the trust's principal.

236. Funk v. Wolf, 144 A.3d 228, 243 (Pa. Commw. Ct. 2016), *aff'd without opinion* 158 A.3d 642 (Pa. 2017).

237. 35 PA. CODE §§ 4001-4015 (2011).

238. *See* 25 PA. CODE §§ 23.1(a)(2)(i), 2(2) (2011).

- Fourth, as discussed below, the regulatory structure should result in actual emissions reductions and not result in the transfer of emissions to other unregulated economic sectors, states or nations through the process of leakage.
- Finally, as suggested in *Funk*, the regulatory structure should be authorized by existing law, or it should be authorized by law that can be implemented administratively without further legislation.[239]

For the reasons discussed below, other measures may be warranted to reduce the cost and effectiveness of a program. However, these criteria support and arguably require the adoption of an economy-wide cap-and-trade program with an auction and reserve price, similar to the program established under the California Global Warming Solutions Act.[240] The regulation should prevent intersectoral "leakage" as well as leakage to other states and nations. The requirements of the ERA support distribution of the tradable allowances through an auction with a reserve price set at the social cost of carbon, except in instances where the award of free allowances or low-cost allowances may be warranted to prevent leakage. The program should be designed to effectively prevent leakage and inefficiencies by allowing interstate and international trading with jurisdictions with similar programs.

Existing Pennsylvania statutes authorize both the regulation of GHG emissions and participation in regional cap-and-trade programs, such as the nine-state Regional Greenhouse Gas Initiative (RGGI) or the California-Quebec-Ontario trading program. "RGGI is a cooperative effort among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont to cap and reduce CO_2 emissions from the power sector."[241] New Jersey is preparing to rejoin RGGI and Virginia has proposed regulations that

239. *See Funk*, 144 A.3d at 250 (noting that "[b]ecause the ERA does not authorize Respondents to disturb the legislative scheme, we must assess whether the actions requested are otherwise made mandatory by the climate change legislative scheme."). This assumes that the General Assembly remains unwilling to enact new legislation and that it will be necessary to induce or judicially compel administrative action. The State of New York has been proceeding to implement its program for reducing GHGs administratively, using executive authority. *See* Thrun v. Cuomo, 976 N.Y.S.2d 320, 323 (N.Y. App. Div. 2013) (dismissing claims against New York Governor's climate change action on jurisdictional grounds, limiting claims to challenges to regulations); Coal. for Competitive Elec. v. Zibelman, 272 F. Supp. 3d 554, 559 (S.D.N.Y. 2017), *appeal filed* (2d Cir. Aug. 25, 2017) (quoting CES Order, app. E, at 1).

240. *See* CAL. HEALTH & SAFETY CODE §§ 38500-38599 (West 2006); CAL. CODE REGS., tit. 17, §§ 95801-96022 (2018). These regulations were changed in 2016 to set more aggressive targets. We are suggesting that the basic structure of the regulatory program — economy wide applicability with an auction and reserve price — should be adopted by Pennsylvania, not necessarily the goals. Pennsylvania goals should be structured to provide a longer term and certain path to carbon neutrality by the 2050s.

241. THE REG'L GREENHOUSE GAS INITIATIVE, https://www.rggi.org/ (last visited Mar. 6, 2018).

would allow trading with RGGI states.[242] The RGGI program has put a descending cap on GHG emissions from the power sector, provides for trading of allowances, and distributes the bulk of allowances through an auction with a reserve price.[243] The California-Quebec-Ontario program creates an economy-wide cap-and-trade program that covers all major GHG emission sources and further requires that distributors of fossil fuels and electricity importers surrender allowances equal to the emissions created by combustion of the fuels or generation of the imported electricity.[244] That program also distributes many allowances by auction with a reserve price.[245] If a rulemaking petition that would facilitate trading in these programs were presented to the EQB, the EQB would have a judicially enforceable constitutional duty to adopt that regulation. As discussed above, such a petition would rely on existing Pennsylvania authority and would describe a reasonably specific rule, thus overcoming the obstacles to mandamus that existed in *Funk*.

A. *An Effective Regulatory Program Will Require Economy-Wide Coverage Under a Cap-and-Trade Program with Additional Measures to Prevent Leakage*

Many legal models would achieve GHG emissions reduction using existing Pennsylvania law. These include a cap-and-trade program with a variety of mechanisms to distribute allowances, an emissions tax, and traditional regulatory techniques (such as technology-based emissions standards and permits that establish limits based on technology or other criteria). Not all of these mechanisms are authorized by current law. Although a mix of other authorized mechanisms can and should be employed as part of an effective program, as discussed below, none can achieve what will be required to meet the constitutional objectives without an economy-wide cap-and-trade program with an auction and reserve price.

An economy-wide GHG emissions tax set at the social cost of carbon and coupled with the leakage prevention measures discussed below could equally satisfy the constitutional prerequisites. However, a tax requires additional legislative action. By contrast, as also discussed below, a cap-and-trade program with an auction

242. 9 VA. ADMIN. CODE § 5-140. Regulation for Emissions Trading Programs (adding 9VAC5-140-6010 through 9VAC5-140-6430), 34 Va. Reg. Regs. 924-59 (Jan. 8, 2018); *see also* Darrell Proctor, *Virginia Moves to Join RGGI Carbon-trading Market*, POWER (Nov. 15, 2017), http://www.powermag.com/virginia-moves-to-join-rggi-carbon-trading-market/.

243. *See Elements of RGGI*, REGIONAL GREENHOUSE GAS INITIATIVE, https://www.rggi.org/program-overview-and-design/elements (last visited Mar. 6, 2018).

244. *See* CAL. AIR RES. BD., CALIFORNIA CAP-AND-TRADE PROGRAM: FACTS ABOUT THE LINKED CAP-AND-TRADE PROGRAMS 1 (2017), https://www.arb.ca.gov/cc/capandtrade/linkage/linkage_fact_sheet.pdf; CAL. AIR RES. BD., CAP-AND-TRADE REGULATION INSTRUCTION GUIDANCE 20-22 (2012), https://www.arb.ca.gov/cc/capandtrade/guidance/chapter2.pdf.

245. *See Reserve Sale Information*, CAL. AIR RESOURCES BOARD (Mar. 16, 2017), https://www.arb.ca.gov/cc/capandtrade/reservesale/reservesale.htm.

and a reserve price can be established by regulation under the existing authority of the APCA and Article I, § 27 without the need for further legislation. Moreover, a carbon tax will not guarantee achieving carbon neutrality by mid-century. A cap-and-trade program with an auction and reserve price and a descending cap reaching carbon neutrality by mid-century would also be at least as effective in reducing GHG emissions as a tax, would better ensure that the mid-century goal would be achieved, and would also recover income for the beneficiaries of the constitutional trust.[246]

Emissions reductions can also be achieved using traditional regulatory approaches. Typically, these approaches rely upon emissions limitations based on reductions that are deemed achievable using a certain technology. This was the technique used to derive the emissions reduction goals for the Clean Power Plan.[247]

Although elements of a command-and-control program (such as permits and emissions monitoring) will be required for any effective program, sole reliance on this typical regulatory approach will not achieve the constitutional objectives for a number of reasons.[248] First, emissions limits based on what a given technology can achieve rather than the emissions reduction goal — *i.e.* the pathway necessary to achieve carbon neutrality by mid-century — are unrelated to the ultimate goal and will often fail to achieve it.[249] By contrast, setting a declining cap based on the trajectory deemed appropriate to achieve the emissions reduction will result in certain reductions. Second, the determination of a technology-based limit is based on an *ex ante* estimate of emissions reduction costs and available technologies and usually results in a lower degree of emissions reduction than can actually be achieved at a

246. A cap-and-trade program with an auction differs from a tax in one key respect. With a tax, the market determines the extent of emissions reductions, and with the cap-and-trade program, the market determines the amount of money that is recovered. The cap-and-trade program with an auction with a reserve price combines the two approaches and best assures emissions reductions. This is because a cap is often initially set too leniently and neither recovers sufficient income nor assures reductions that can be achieved cost-effectively. Thus, when a cap is set too leniently, the reserve price in the auction results in excess allowances not being sold, acting as a tax and achieving additional cost-effective reductions. The California Court of Appeals held that California's GHG allowance auction (which utilizes a reserve price) is not a tax. Cal. Chamber of Commerce v. State Air Res. Bd., 216 Cal. Rptr. 3d 694, 700 (Cal. Ct. App. 2017) ("These twin aspects of the auction system, voluntary participation and purchase of a specific thing of value, preclude a finding that the auction system has the hallmarks of a tax.").

247. *See* 40 C.F.R. pt. 60 (2017); *see also* Repeal of Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 82 Fed. Reg. 48,035, 48,037 (proposed Oct. 16, 2017) (to be codified at 40 C.F.R. pt. 60) (proposing a repeal of the Clean Power Plan in part because the "rule established performance standards for coal-fired plants assuming a uniform emissions rate well below that which could be met by existing units through any retrofit technology of reasonable cost available at the time").

248. *See* McKinstry, Peterson & Chester, *supra* note 192, at 10139-41 (discussing why a technology-based approach such as that applied in the Clean Power Plan is unlikely to result in the reductions necessary to achieve the objectives of the Paris Agreement).

249. *Id.* at 10140.

given cost.[250] Third, as discussed below, it would be more difficult and perhaps impossible to prevent leakage[251] using a technology-based regulatory approach. Fourth, the process of reviewing technologies and developing standards is time and energy intensive, and the standards are unlikely to be put in place within a time frame necessary to achieve the necessary reductions.[252] Fifth, although technology-based standards are intended to be technology forcing, hard caps coupled with an increasing reserve price would better inform the market in advance and would be more likely to drive the necessary capital investment. Sixth, a traditional regulatory approach would not generate income for the beneficiaries of the constitutional trust.

Still, regulatory approaches could be helpful to address situations where the market does not function efficiently.[253] California employs a number of supplemental measures to address these situations.[254] For example, as a part of its cap-

250. In virtually all cases, emissions reductions have been achieved at a significantly lower cost than originally estimated. This means that a cap-and-trade program with a reserve price set at the social cost of carbon will likely result in more emissions reductions than might be achieved by attempting to determine what technologies could be employed at the social cost of carbon and establishing emissions limits based on those technologies. For example, in the Clean Power Plan, EPA based its determination of the required emissions reductions on an *ex ante* determination of what could be achieved by a suite of technologies. Analyses of the CPP concluded that allowance prices would initially be zero, meaning that the required "reductions" would be no greater than business as usual. McKinstry, Peterson & Chester, *supra* note 192, at 10139, n. 35; *see also id.* at 10140; David M. Driesen, *Is Emissions Trading an Economic Incentive Program?: Replacing the Command and Control/Economic Incentive Dichotomy*, 55 WASH. & LEE L.R. 289, 318-19 (1998).

251. The concept of leakage is discussed in the following section.

252. For example, 40 C.F.R. § 60, which establishes standards of performance for new stationary sources of air pollutants for various industrial categories, now contains subparts A through UUUU, with each subpart generally addressing a different industrial category. 40 C.F.R. § 60 (2016). In the decade following *Massachusetts v. EPA*, EPA has established technology-based standards for just one category, new and existing power plants, 40 C.F.R. § 60, subparts TTT & UUUU, and those standards have been stayed and are under reconsideration. Moreover, as discussed above, the standards were outdated even before implementation, such that the new source standards were weaker than the emissions being achieved by existing combined cycle natural gas-fired plants, and the standard for existing power plants was no better than business as usual. McKinstry, Peterson & Chester, *supra* note 192, at 10139-40.

253. *See* Daniel Shawhan, *Reductions and "Leakage" from US State Cap-and-Trade Programs* (Sept. 19, 2013), http://www.rff.org/files/sharepoint/Documents/Events/Workshops%20and%20Conferences/Shawhan-presentation.pdf; MEREDITH L. FOWLIE, MAR REGUANT, & STEPHEN P. RYAN, MEASURING LEAKAGE RISK 13 (2016), https://www.arb.ca.gov/cc/capandtrade/meetings/20160518/ucb-intl-leakage.pdf.

254. *E.g.*, CAL. AIR RES. BD., CALIFORNIA'S 2017 CLIMATE CHANGE SCOPING PLAN, THE STRATEGY FOR ACHIEVING CALIFORNIA'S 2030 GREENHOUSE GAS TARGET (2017), https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf. The additional measures include California's renewable portfolio standard (RPS); a low carbon fuel standard; a multi-faceted mobile source strategy (including vehicle fleet standards, measures for encouraging the electrification of the vehicle fleet, and transportation and land use planning to reduce vehicle miles traveled); standards to reduce emissions of methane and carbon black as well as use of HFC's; and measures to improve freight efficiency. *Id.* at 25, Table 1.

and-trade program, the state imposes a price on fuel based on the GHG emissions from its combustion by requiring fuel suppliers to acquire and surrender allowances. However, this approach will not readily produce emissions reductions if manufacturers do not make lower emissions vehicles available, or if suppliers do not make low carbon fuels available, or if homebuyers do not consider utility costs in deciding whether to purchase energy efficiency measures rather than granite countertops in their new homes.[255] Therefore, measures like fleet emissions limits, fuel content requirements, and building codes requiring energy efficiency all reduce the cost of emissions reductions and can achieve greater emissions reductions when coupled with a cap-and-trade program. California includes measures such as these to support its cap-and-trade program.[256] However, without the uniform ceiling created by the cap, and without the uniform price floor created by the reserve price, those measures alone will not achieve the emissions reductions within the time necessary to conserve and maintain a stable climate.

B. *The Significance of Leakage*

Both constitutional and practical policy considerations call for the implementation of a policy program that prevents or at least minimizes the phenomenon of "leakage." Leakage refers to increases in emissions in unregulated sectors or unregulated jurisdictions that are caused by the relocation of emissions-generating activity away from the regulated sector or jurisdiction.[257] Leakage can occur because a business shifts some or all of its production to other states or nations. Leakage may also occur between sectors. If the result of regulation is an increase of emissions in other sectors, in other states, or in other nations, at least some of the damage to the natural resources will occur in any case.

1. Types of Leakage

Interstate leakage occurs in the electricity sector, where electrons flow readily across state boundaries and where generation units are called upon to supply electricity to the grid in order of price.[258] For example, if Pennsylvania puts a price on carbon but West Virginia does not, then generation units in West Virginia would not include an emissions price in their bids, and they would be able to submit lower bids. This would move the West Virginia units up in the order in which they are called. In some cases, this might result in a West Virginia coal-fired plant being

255. Although emissions reductions will ultimately occur even without the supplemental measures, a much higher price must be imposed without the supplemental measures.

256. *Supra* note 254, at ES16.

257. *See* Shawhan, *supra* note 253, at slide 5; FOWLIE ET AL., *supra* note 253, at 13.

258. Fed. Energy Regulatory Comm'n v. Elec. Power Supply Ass'n, 136 S. Ct. 760, 768-69 (2016) (describing the structure of competitive, interstate electricity markets).

called upon before a combined cycle natural gas plant in Pennsylvania, which has only about 40% of the emissions of the coal-fired plant.[259] In that case, even though Pennsylvania coal-fired plants would operate less frequently, some of the emissions reductions would be offset by increased emissions from coal-fired plants in West Virginia operating more frequently. This type of leakage can also occur in regulatory regimes. If Pennsylvania requires the installation and operation of carbon capture and sequestration control equipment on its fossil-fired plants and West Virginia does not, the dispatch of electricity could also shift to West Virginia.

The EPA addressed interstate leakage of conventional air pollutants in its Cross-State Air Pollution Rule implementing the Clean Air Act's Good Neighbor provision.[260] The EPA based its allowance caps and state budgets on models using a uniform allowance price.[261] In essence, this created a program imposing a uniform price across state boundaries to prevent leakage.[262] Similar mechanisms to put a uniform price on emissions will be required for programs requiring GHG emissions reductions in the electricity sector.

Leakage has been a significant problem for the RGGI cap-and-trade program, which is limited to the electricity sector. Although the RGGI program has achieved significant emissions reductions in RGGI states, a portion of those reductions has caused the shifting of dispatch to higher emitting fossil fuel-fired facilities in Pennsylvania and other states.[263] This leakage not only limits the effectiveness of the RGGI program to reduce overall emissions, but also depresses RGGI

259. The national emissions data gathered by EPA and reported in the technical support documents for the Clean Power Plan indicated that in the Eastern Interconnection coal-fired plants emitted 1,356,066 thousand tons of carbon dioxide while producing 1,230,444 GWh of electricity for an emission rate of 1,102 tons/GWh, while combined cycle natural gas-fired plants emitted 328,220 thousand tons of carbon dioxide while producing 734,335 GWh, for an emission rate of 447 tons/GW/h, or 40.6% of the average rate for the coal-fired fleet. ENVTL. PROT. AGENCY, OFFICE OF AIR & RADIATION, CO_2 EMISSION PERFORMANCE RATE AND GOAL COMPUTATION TECHNICAL SUPPORT DOCUMENT FOR CPP FINAL RULE 10, Table 3 (2015), https://archive.epa.gov/epa/sites/production/files/2015-11/documents/tsd-cpp-emission-performance-rate-goal-computation.pdf.

260. Federal Implementation Plans: Interstate Transport of Fine Particulate Matter and Ozone and Correction of SIP Approvals, 76 Fed. Reg. 48,208 (August 8, 2011) (Cross-State Air Pollution Rule), *aff'd* Envtl. Prot. Agency v. EME Homer City Generation, L.P., 572 U.S. 32 (2014); U.S. ENVTL. PROT. AGENCY, OFFICE OF AIR & RADIATION, CROSS-STATE AIR POLLUTION RULE, REDUCING AIR POLLUTION PROTECTING PUBLIC HEALTH (2011).

261. *See* 76 Fed. Reg. 48,248-53.

262. In the Cross-State Air Pollution Rule, EPA created state budgets based on air quality needs and the cost of "highly cost effective reductions," and it imposed uniform costs to prevent leakage. The U.S. Supreme Court recognized the problem of leakage and approved this approach to dealing with it in *Envtl. Prot. Agency v. EME Homer City Generation, L.P.*, 572 U.S. ___, at 4 (2014).

263. SUE WING & MAREK KOLODZIEJ, THE REGIONAL GREENHOUSE GAS INITIATIVE: EMISSION LEAKAGE AND THE EFFECTIVENESS OF INTERSTATE BORDER ADJUSTMENTS 4 (2008), https://sites.hks.harvard.edu/m-rcbg/rpp/Working%20papers/RPP_2008_03_SueWing.pdf.

allowance prices.[264] Allowance prices are so depressed by this leakage that New York needed to adopt a mechanism requiring electricity distribution companies to buy zero emission credits (ZECs) based on the social cost of carbon in order to prevent the premature closure of non-emitting nuclear units.[265]

Interstate and international leakage may occur in other industries, although not as readily as in the electricity industry. In the case of electricity generation, shifting dispatch of electricity units from one state to another based on price occurs immediately. However, products in other industries are not as readily fungible, and leakage may lead to the closing of a plant or moving production.[266] The differ-

264. In the RGGI program, the California cap-and-trade program and other similar programs, an allowance represents the right to emit one metric ton of carbon dioxide or its equivalent. *See* RGGI 2017 MODEL RULE, at 4; CAL. CODE REGS., tit. 17, § 95802(8) (2018); These programs auction or otherwise distribute a number of allowances equal to the cap. *See Elements of RGGI*, *supra* note 244. Each regulated party must surrender a number of allowances equal to its emissions (or the emissions produced by the regulated products in the case of the California program) at the end of the applicable compliance period.

265. Coal. for Competitive Elec. v. Zibelman, 272 F. Supp. 3d 554, 561-63 (S.D.N.Y. 2017), *appeal filed* (2d Cir. Aug. 25, 2017) (quoting CES Order, app. E, at 1).

266. If a price is put on emissions from industries such as steel and fertilizer production in one state, production costs will increase in that state and a company might switch production to another plant in a state or nation that does not put a price on emissions. In that case, emissions will still occur, but in a different location. The disparity in production costs may cause a plant to close, shifting production elsewhere.

It is important to note that the electricity industry is fundamentally different from industries such as steel and fertilizer production. Electricity production must occur within a relatively limited geographic area that is tied to the consumer by the grid and is sufficiently proximate to prevent excessive transmission losses. For the most part, electricity cannot be stored and, although storage technologies are improving, they are still very limited; storage can occur for only a short period of time. Electricity therefore relies upon markets in which generation sources that can be turned on or off are called upon in the order of bids, and all electricity generators receive a price based upon the highest bid that is called upon. The bids are based on marginal operating costs and not on fixed or capital costs. Non-emitting sources, such as nuclear or most renewable generation sources, do not have significant marginal operating costs and cannot readily be turned on or off. These non-emitting sources, therefore, submit zero or negative bids and rely upon the bids of fossil generators to set the price of electricity that the non-emitting sources receive. If electricity prices are not sufficiently high, companies will not invest capital necessary to expand the capacity of non-emitting generation or to keep that generation operating. The fossil sources set their bids above their net marginal operating costs, which are based on the cost of fuel, pollution control and other marginal costs. If a fossil generator receives an allowance based on its production, that allowance will produce operating revenue offsetting the operating costs, allowing all fossil generators to submit lower bids. Lower electricity prices will reduce the amount of non-emitting generation by reducing the return on capital. In some cases, it may also move higher emitting facilities, such as coal-fired plants, up in the order of dispatch, thereby increasing emissions. For a discussion of wholesale electricity markets, *see* Fed. Energy Regulatory Comm'n v. Elec. Power Supply Ass'n, 136 S. Ct. 760, 768-72 (2016).

By contrast, steel and fertilizers operate in international markets and can be stored for long period of time in warehouses, so that the actions of a single state or even a group of states such as RGGI will not affect the price of a ton of steel or of fertilizer. If these industries are awarded allowances based on production, it will not affect price but will still create a strong incentive to reduce emissions and thereby

ence in industry structure may necessitate different leakage control mechanisms, as discussed in the next subsection.

Finally, if emissions control requirements are imposed or an emission price is imposed on the electricity sector but not on other sectors, then the other sectors may switch from electricity use to the use of fossil fuels. For example, if a price is put on emissions from the electricity sector but not on the transportation sector, electric cars and plug-in hybrids will be more expensive compared to vehicles with internal combustion engines, deterring the emissions reductions that would occur as a result of electrification of the transportation sector. This can also occur in the area of building heating and cooling. If a price is put on emissions from the electricity industry but not on heating oil or natural gas, it will encourage direct use of fossil fuels for heat instead of non-emitting electric heating, even in buildings that use non-fuel mechanisms to increase heating efficiency, such as ground source geothermal.[267] Leakage may also affect production technology choice. For example, steel can be manufactured using an electric arc furnace, which uses electricity, or an open-hearth furnace, which uses coal. Increasing the cost of electricity emissions and the cost of electricity without putting a price on emissions from the electric hearth unit may cause leakage by shifting some production to the open-hearth technology.

2. Mechanisms to Prevent Leakage

The regulatory mechanisms employed by California pursuant to the Global Warming Solutions Act reflect consideration of each of these forms of leakage. To prevent intersectoral leakage, California has created an economy-wide cap-and-trade program applicable to GHG emissions from the electricity sector; emissions from other major air pollution sources; the import of electricity; and the sale of natural gas, heating oil, and gasoline.[268] Interstate leakage in the electricity sector is controlled by requiring that importers of electricity surrender allowances equal to the GHG emissions resulting from the electricity generation.[269] Interstate and international leakage from sectors vulnerable to international and interstate compe-

reduce costs. This will reduce and possibly eliminate the incentive to shift production to another state or country or to abandon capital by shutting a plant down.

267. Heat pumps are more efficient than other forms of electric heating, and ground source geothermal increases the efficiency of heat pumps significantly by allowing them to discharge heat into the subsurface while cooling and to pull heat from the subsurface while heating. Because the subsurface maintains a constant temperature over the seasons, the heat pump is able to operate at maximum efficiency, reducing the amount of electricity used and emissions that may be associated with that electricity.

268. CAL. CODE REGS. tit. 17, § 95101 (2018) (covered entities); *see generally* California Global Warming Solutions Act, CAL. HEALTH & SAFETY CODE §§ 38500-38599 (West 2018); CAL. CODE REGS., tit. 17, §§ 95801-96022 (2018).

269. CAL. CODE. REGS. tit. 17, §§ 95101(b), 95852(b)(3) (2018).

tition is prevented by awarding allowances to those industries rather than requiring the allowances to be purchased at auction.[270]

The RGGI states attempt to eliminate leakage among the participating states through the creation of a uniform trading program, so that generators in the nine states will face similar costs and cannot benefit by switching dispatch or investment to other RGGI states.[271] Nevertheless, leakage has occurred as dispatch is switched to other nearby states that do not regulate GHG emissions or put a price on those emissions. For RGGI, as in Pennsylvania, it is impractical to require the surrender of allowances for imported electricity, as would happen in California.

PJM Interconnection, LLC (PJM), the regional transmission organization that oversees the dispatch and transmission of electricity in Pennsylvania and several RGGI states,[272] as well as New York Independent System Operator (NYISO) and Independent System Operator New England (ISO New England), are currently exploring mechanisms to prevent leakage and the market distortions caused by some states' failure to put an adequate price on GHG emissions. The mechanisms include border adjustments made by way of "carbon adders" that are placed on bids from fossil fuel-fired units in states without regulation or other border charges. NYISO commissioned a study "to explore whether and how New York State environmental policies limiting carbon may be pursued within the existing wholesale market structure."[273] The NYISO study explained how, for the purpose of deciding the order in which generation units would be "dispatched" or called upon, border adjustments could assign a price or "carbon adder" that would be added to imports based on the generator's emissions and the price within New York.[274] Exporters from New York would receive a credit based on the emissions charges.[275] PJM, which involves multiple states, has gone further and described a mechanism that

270. *Id.* § 95891.

271. *See generally* RGGI 2017 MODEL RULE.

272. The interconnection itself is known as the Pennsylvania-New Jersey-Maryland Interconnection. PJM includes Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, and the District of Columbia.

In regions where electric utilities were restructured such that generation was deregulated (*i.e.* became competitive), regional transmission organizations (RTOs) and independent service operators (ISOs) manage wholesale electricity transmission, deciding which generation units should be dispatched. In other regions, the electricity transmission and generation are handled by traditional vertically integrated utilities. *See* CONG. RESEARCH SERV., REPORT R44783, FEDERAL POWER ACT (FPA) AND ELECTRICITY MARKETS (2017).

273. SAMUEL A. NEWELL ET AL., N.Y. DEP'T. OF PUB. SERV., N.Y. INDEP. SYS. OPERATOR, PRICING CARBON INTO NYISO'S WHOLESALE ENERGY MARKET TO SUPPORT NEW YORK'S DECARBONIZATION GOALS iv (2017), https://www.energymarketers.com/Documents/Brattle_study_carbon_pricing.pdf.

274. *Id.* at 23-26.

275. *Id.* at 24.

would create subregions to prevent leakage across regulated and unregulated regions by way of a two-stage process.[276]

Notably, the various mechanisms for limiting interstate and intersectoral leakage cannot operate effectively without a cap-and-trade program that imposes a uniform price on emissions.[277] Therefore, at a minimum, an effective program will require such a cap-and-trade program with the opportunity to trade with other similar programs.[278]

C. *Authority to Regulate Greenhouse Gas Emissions Under the Pennsylvania Air Pollution Control Act*

The Commonwealth Court reasoned in the *Funk* decision that existing legislative authority to limit GHG emissions is a necessary basis for obtaining judicial relief requiring regulatory action to limit those emissions.[279] The court's decision was based on well-founded separation of powers concerns.[280] As also noted in *Funk*, and explained in greater detail below, regulation of GHG emissions is authorized under the APCA.[281] This statute governs the air pollution control program in Pennsylvania and authorizes the type of cap-and-trade program described above. The APCA authorizes the EQB to adopt air pollution regulations,[282] and the EQB has rules governing the submission of petitions for rulemaking under the

276. PJM, ADVANCING ZERO EMISSIONS OBJECTIVES THROUGH PJM'S ENERGY MARKETS: A REVIEW OF CARBON-PRICING FRAMEWORKS (2017), http://pjm.com/~/media/library/reports-notices/special-reports/20170502-advancing-zero-emission-objectives-through-pjms-energy-markets.ashx. These leakage prevention mechanisms require approval by the Federal Energy Regulatory Commission.

277. The leakage control mechanisms rely upon a fungible price to eliminate interstate disparities caused by the state's putting a price on GHG emissions. If a state relied on a more traditional regulatory approach, such as establishing emissions limits, it would lack jurisdiction to impose those limits on other states or nations. A regulatory approach is insufficiently fungible to allow a state to impose a charge that equalizes the effect, particularly in light of the dormant commerce clause. U.S. CONST., art. I, § 8, cl. 3.

278. Clean Air Rule, WASH. ADMIN. CODE § 173-442-100 (2016). The State of Washington Department of Ecology has adopted a Clean Air Rule, which creates a different type of program that requires annual percentage GHG emissions reductions and allows the use of tradeable emissions allowances from other states to satisfy the emissions reduction obligation. *See generally* WASH. ADMIN. CODE § 173-442. This regulation has been suspended because of a decision partially invalidating it. Regardless, this approach would not be applicable to Pennsylvania because it would not generate income for beneficiaries of the trust. Although it assures emissions reductions, the ability to trade under the program ultimately depends upon other jurisdictions creating tradable allowances with a transparent price.

279. Funk v. Wolf, 144 A.3d 228, 235, 248-49 (Pa. Commw. Ct. 2016) *aff'd without opinion*, 158 A.3d 642 (Pa. 2017).

280. *Id.* at 235.

281. 35 PA. CONS. STAT. § 4001-4015 (2011).

282. *Id.* § 4005.

APCA.[283] The APCA further authorizes DEP to administer air regulatory programs, including regulations adopted by the EQB.[284]

The APCA provides DEP with the authority to regulate air pollution in accordance with the federal Clean Air Act.[285] The APCA states that DEP "shall have the power and its duty shall be to [i]mplement the provisions of the Clean Air Act in the Commonwealth."[286] The Act further provides that the EQB "[s]hall have the power and its duty shall be to [a]dopt rules and regulations to implement the provisions of the Clean Air Act," which "shall be consistent with the requirements of the Clean Air Act and the regulations adopted thereunder."[287] These provisions suggest that the EQB has broad authority to promulgate regulations consistent with the requirements of the Clean Air Act and that DEP has authority to implement the provisions of the federal Clean Air Act.

The statute further provides that no operating permit may be issued by DEP unless it determines that the source will not discharge air contaminants "in violation of any performance or emission standard or other requirement" established by EPA or DEP.[288] Further, DEP must revise any permit to incorporate applicable standards and regulations promulgated under the Clean Air Act after issuance of the permit in accordance with a timeframe set forth in the statute.[289] Because GHGs are now clearly pollutants under the Clean Air Act,[290] DEP must regulate those gases, at least to the extent set out in the federal Clean Air Act. This includes control of new or modified major stationary sources emitting 75,000 tons or more of greenhouse gases if that source also emits other pollutants regulated under the Clean Air Act.[291]

283. 23 PA. CODE §§ 23.1-23.8 (2011).

284. 35 PA. CONS. STAT. § 4004.

285. 42 U.S.C. §§ 7401-7671q (1970).

286. 35 PA. CONS. STAT. § 4004(1) (2011).

287. *Id.* § 4005(a)(8).

288. *Id.* § 4006.1(b)(2).

289. *Id.* § 4006.1(k).

290. Coal. for Responsible Regulation, Inc. v. U.S. Envtl. Prot. Agency, 684 F.3d 102 (D.C. Cir. 2012) *aff'd in part and rev'd in part on other grounds sub nom*; Util. Air Regulatory Grp. v. Envtl. Prot. Agency, 134 S. Ct. 2427 (2014); *see also* Funk v. Wolf, 144 A.3d 228, 250, n.17 (Pa. Commw. Ct. 2016), *aff'd without opinion*, 158 A.3d 642 (Pa. 2017)

291. In *UARG*, the U.S. Supreme Court upheld EPA regulation requiring control of greenhouse gases emitted by sources otherwise subject to Prevention of Significant Deterioration (PSD) review in quantities of at least 75,000 tons per year of carbon dioxide equivalent. Prevention of Significant Deterioration and Title V Permitting for Greenhouse Gases: Removal of Certain Vacated Elements, 80 Fed. Reg. 50,199 (Aug. 19, 2015); *see also Funk*, 144 A.3d at 250 n.17.

The Clean Power Plan, which would limit GHG emissions from power plants, has been stayed until all legal challenges are resolved. West Virginia v. Envtl. Prot. Agency, 136 S. Ct. 1000, 1000 (2016). Certain other rules limiting GHG emissions are under reconsideration by EPA. Still, these regulations remain on the books. There are many other laws and regulations limiting GHG emission under the Clean Air Act that remain in force and are not under reconsideration. More significantly, there are

The EQB's duty to adopt regulations limiting GHG emissions goes beyond the minimum that may be required under the Clean Air Act, even without considering the Commonwealth's duty as a trustee under the ERA. The APCA provides the EQB with the authority and the mandatory duty to:

> Adopt rules and regulations, for the prevention, control, reduction and abatement of air pollution, applicable throughout the Commonwealth or to such parts or regions or subregions thereof specifically designated in such regulation which shall be applicable to all air contamination sources regardless of whether such source is required to be under permit by this act.[292]

Those rules and regulation may, among other things, "prohibit or regulate any process or source or class of processes or sources."[293] Further, the APCA authorizes the Department to:

> Prepare and develop a general comprehensive plan for the control and abatement of existing air pollution and air contamination and for the abatement, control and prevention of *any new* air pollution and air contamination . . . and to submit a comprehensive plan to the [EQB] for its consideration and approval.[294]

The APCA defines "air contaminant" to include a "gas," which would therefore include greenhouse gases.[295] The statute defines "air contamination" as the "presence in the outdoor atmosphere of an air contaminant which contributes to any condition of air pollution."[296] It further defines "air pollution" as:

> The presence in the outdoor atmosphere of any form of contaminant, including, but not limited to, the discharging from stacks, chimneys, openings, buildings, structures, open fires, vehicles, processes or any other source of any . . . gases, vapors, . . . or any other matter in such place, manner or concentration inimical or which may be inimical to the public health, safety or welfare or which is or may be injurious to human, plant or animal life or to property or which unreasonably interferes with the comfortable enjoyment of life or property.[297]

substantial arguments that GHG emissions from power plants and other stationary sources must be regulated under section 111 of the Clean Air Act. *See* American Elec. Power Co. v. Connecticut, 564 U.S. 410 (2011).

292. 35 PA. CONS. STAT. § 4005(a)(1) (2011).

293. *Id.*

294. *Id.* at § 4004(18) (emphasis added).

295. *See id.* § 4003 (definition of "air contaminant").

296. *Id.* § 4003 (definition of "air contamination").

297. *Id.* § 4003 (definition of "air pollution").

The EPA endangerment finding under the Clean Air Act, the 2015 DEP report under the Climate Change Act, and a wide variety of other scientific studies support the conclusion that GHGs constitute air pollution.[298]

Moreover, the Climate Change Act requires not only a report on greenhouse gas impacts every three years but also requires DEP to develop a climate change action plan for submission to the Governor identifying "cost-effective strategies for reducing and offsetting GHG emissions."[299] This provision would not make sense unless the APCA allowed regulation of GHGs. The fact that the plan is submitted to the administrative branch rather than the legislative branch suggests that the General Assembly contemplated that the administrative branch could implement those strategies through rulemaking and other actions already authorized by the General Assembly. Thus, DEP has authority under existing law to regulate GHGs through adoption of regulations by EQB, even in the absence of regulations under the federal Clean Air Act. [300]

Case law also supports this position. In *Commonwealth, Department of Environmental Resources v. Pennsylvania Power Co.*,[301] the Commonwealth Court held

298. *See* Massachusetts v. Envtl. Prot. Agency, 549 U.S. 497, 528-530 (2007) (analysis of why greenhouse gases are air pollutants under the Clean Air Act).

299. *See* 71 PA. CONS. STAT. §§ 1361.3, 1361.7 (2018). Although the Act also requires the Plan to recommend legislative changes, this should not be read to suggest that existing law does not authorize comprehensive regulation.

300. The APCA limits the stringency of some regulations that the EQB may adopt. These limitations are unlikely to apply to regulations limiting GHG emissions even assuming that they are constitutional under the Court's decisions in *Robinson Twp.* and *PEDF*. Section 4004.2 of the APCA prohibits regulation beyond that necessary to meet the minimum requirements of the federal Clean Air Act for purposes of implementing section 109 of the Clean Air Act, which relates to "criteria pollutants" governed by National Ambient Air Quality Standards (NAAQS) established for GHGs. *See* 35 PA. CONS. STAT. § 4004.2 (2018). That section does not apply because EPA has not established a NAAQS for GHGs. Even if EPA establishes a NAAQS for GHGs in the future, it must be set at a level sufficient to protect public health and welfare. *See* 42 U.S.C. § 7409 (2012). Achieving and maintaining that NAAQS will require emissions reductions commensurate with the social cost of carbon so that the regulation described here would be consistent with that section. Further, the EQB may not establish "a more stringent performance or emission standard for hazardous air pollutant emissions from existing sources" than federal section 112 standards. 35 PA. CONS. STAT. § 4006.6(a) (2018); *see* PPL Generation, LLC v. Commonwealth, Dep't of Envtl. Prot., 986 A.2d 48, 50-51 (Pa. 2009). That section does not apply because greenhouse gases are not considered "hazardous air pollutants," which is a narrow term referring to air pollutants that present "a threat of adverse human health effects." *See* 42 U.S.C. § 7412(b)(1) (list of hazardous air pollutants that does not include greenhouse gases); *Id.* § 7412(b)(2) (criteria for revising the list, which emphasize that only pollutants which present a threat of adverse human health effects may be added and explicitly excludes substances added solely "due to [their] adverse effects on the environment.").

301. Commonwealth, Dep't of Envtl Res. v. Pa. Power Co., 384 A.2d 273, 284-85 (Pa. Commw. Ct. 1978)

> After careful consideration of the CAA, the APCA and the pertinent legislative histories thereto, we must agree with DER and conclude that the purpose behind the APCA and the provisions contained therein is to provide the people of this Commonwealth with air which is of a higher quality than that required by federal law.

that the APCA authorized regulations more stringent than federal regulations.[302] In addition, the Pennsylvania Supreme Court recognized that Article I, § 27 authorizes DEP to adopt regulations going beyond the statutory minimum in order to implement a statute's legislative purposes.[303] In *Funk*, as previously noted, the Commonwealth Court noted that DEP and other state respondents "acknowledge that the General Assembly, through the APCA, bestowed upon them a duty to promulgate and implement rules and regulations to reduce CO_2 and GHG emissions."[304]

The APCA also contains sufficient authority to extend regulations throughout the economy, by going "upstream" and regulating fossil fuels where it is impractical to regulate the emissions source. It is impractical to require that vehicles and individual homes and buildings measure emissions and surrender allowances.[305] The RGGI program and the proposed Virginia emissions trading program cover only certain larger electricity-generating facilities,[306] whose GHG emissions are measured and reported under federal law[307] and can therefore can be readily regulated. These programs nonetheless fail to capture the majority of GHG emissions[308] and therefore allow intersectoral leakage. By contrast, the California-Quebec-Ontario cap-and trade-program extends to all major air pollution emissions sources where emissions can be measured, and also extends to sectors where it

rev'd in part on other grounds, 426 A.2d 995 (1980).

302. *Commonwealth, Dep't of Envtl. Res.*, 384 A.2d at 284.

303. Eagle Envtl. II, L.P. v. Commonwealth, Dep't of Envtl. Prot., 144 A.3d 228 (2005).

304. *Id.* at 250.

305. These small sources are not individually regulated under federal or state law and are not required individually to obtain a permit or to measure or report emissions. Regulating the millions of sources individually would create an undue administrative burden for both the regulators and the regulated community. Indeed, EPA deemed it impractical to regulate even larger sources of GHG emissions that would exceed a 250 ton per year threshold and, for that reason the Supreme Court in *UARG* defined the use of the term "pollutant" in the new source review provisions of the Clean Air Act to exclude carbon dioxide. Individual homes and vehicles generally emit GHGs at lower levels and their individual regulation would be even less feasible.

306. CO_2 BUDGET TRAINING PROGRAM GENERAL PROVISIONS, MODEL RULE, § XX-1.4(a), (REG'L GREENHOUSE GAS INITIATIVE) 2017, https://www.rggi.org/sites/default/files/Uploads/Program-Review/12-19-2017/Model_Rule_2017_12_19.pdf; 9 VA. ADMIN. CODE §§ 5-140-10 to 5-140-260, Regulation for Emissions Trading Programs, 9VAC5-140 (Jan. 8, 2018).

307. Mandatory Reporting of Greenhouse Gas Emissions, 40 C.F.R. § 90 (2012).

308. U.S. ENVTL. PROT. AGENCY, INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990-2016 ES-6 to ES-7 (2018), https://www.epa.gov/sites/production/files/2018-01/documents/2018_complete_report.pdf (In 2016, the entire electric power sector in the United States emitted 1,809.3 million metric tons of carbon dioxide, or 34.1 percent of the total 5,310.9 million metric tons of carbon dioxide emitted by all sectors (transportation, industrial, residential, commercial and U.S. territories in addition to the electric power sector) and 27.8 percent of the total 6,511.3 million metric tons of emissions when all categories of GHGs (methane, nitrous oxide, HFCs, PFCs, SF_6 and NF_3 in addition to carbon dioxide) are included).

is infeasible to regulate the emissions source.[309] That program also requires that those distributing fossil fuels within the state or importing electricity or fuels acquire allowances, and therefore captures the majority of GHG emissions and more effectively prevents leakage.[310] This vastly more effective program is authorized by existing law in Pennsylvania.

The APCA authorizes and gives the EQB the power and the duty to adopt regulations applicable to "all air contamination sources regardless of whether such source is required to be under permit by this act" and states that these regulations may "prohibit or regulate the combustion of certain fuels."[311] This authorization appears to encompass the broader and more effective California-Quebec-Ontario approach, particularly when read in light of the Commonwealth's duty as a trustee under the ERA.

There are cogent reasons for adopting the broader California-Quebec-Ontario approach and interpreting the APCA to support that approach. Most notably, it prevents leakage between sectors subject to a carbon price and those not subject to a price. For example, if electricity prices rise as a result of putting a price on carbon emissions, and if the price of GHG emissions is not reflected in the price of motor vehicle fuels, this may discourage the purchase and use of electric vehicles, resulting in increased emissions of both GHGs and conventional pollutants. If electricity prices increase as a result of regulations and an equivalent price is not reflected in the price of natural gas and home heating oil, the price disparity may discourage electrification of the building sector and many industries. Electrification of these sectors will be required to achieve carbon neutrality by mid-century, as required to conserve and maintain a stable climate.

As noted above, interstate emissions trading with uniform pricing is one of the mechanisms necessary to prevent leakage. The Pennsylvania Uniform Interstate Air Pollution Agreements Act authorizes participation in interstate trading programs.[312] That Act encourages DEP to coordinate and cooperate with "State and local authorities of other states affected by air sheds or regional air masses lying partly within another state or states, or moving between or among this State and another state or states."[313] This statute, along with the broad authorizations in the APCA to address air pollution and to implement the Clean Air Act as interpreted by Pennsylvania courts, appears to authorize Pennsylvania to develop and participate in interstate trading arrangements that would put a price on carbon. These

309. CAL. CODE REGS. tit. 17, § 95811(a)-(h) (2012); *see also* CAL. LEGISLATIVE ANALYST'S OFFICE, THE 2017-18 BUDGET: CAP-AND-TRADE 5 (2017), http://www.lao.ca.gov/reports/2017/3553/cap-and-trade-021317.pdf.

310. CAL. LEGISLATIVE ANALYST'S OFFICE, *supra* note 309

311. 35 PA. CONS. STAT. § 4005(a)(1) (1992).

312. 35 PA. CONS. STAT. §§ 4101-4106 (1972).

313. *Id.* § 4103(a); *see also id.* § 4101 (making it the policy of Pennsylvania to encourage interstate cooperation and agreements).

include RGGI; the broader programs being implemented by California, Quebec, and Ontario; the trading-ready program being developed by Virginia;[314] or a similar interstate or regional arrangement involving emissions trading or other mechanisms to put a price on GHG emissions or otherwise limit those emissions.[315]

Under RGGI, allowances are auctioned by each state and a portion of the auction revenue (or a portion of the allowances themselves) must be devoted to strategic energy purposes.[316] Although the APCA lacks specific authorization for auc-

314. Joining or leaving RGGI is arguably an action within the purview of the governor's executive power, even without other authority. Both the Governor of New York, in joining RGGI, and the Governor of New Jersey, in leaving RGGI, relied on their executive power. *See, e.g.*, Thrun v. Cuomo, 976 N.Y.S.2d 320, 323 (N.Y. App. Div. 2013); *In re* Reg. Greenhouse Gas Initiative, No. A-4878-11T4 (N.J. Super. Ct., App. Div. Mar. 25, 2014) (holding that notice and comment rulemaking is required before withdrawing rules implementing RGGI in response to Governor Christie's withdrawal from RGGI). The Governor of Virginia has issued an Executive Order directing the creation of a cap-and-trade program for the electricity sector. Executive Directive 11 (2017), http://governor.virginia.gov/media/9155/ed-11-reducing-carbon-dioxide-emissions-from-electric-power-facilities-and-growing-virginias-clean-energy-economy.pdf. Pursuant to that Order, the State has published a proposed regulation that mirrors the RGGI program and would allow trading even without Virginia joining RGGI. *See* 9 VA. ADMIN. CODE § 5-140. Regulation for Emissions Trading Programs (adding 9VAC5-140-6010 through 9VAC5-140-6430), 34 Va. Reg. 924 (Jan. 8, 2018).

315. *See* 35 PA. CONS. STAT. § 4103(b) (2011). The Act imposes limitations on such agreements, requiring that DEP not delegate its enforcement authority to other states or agencies and limiting appropriation authority and authority to pledge credit. 35 PA. CONS. STAT. § 4105 (2011). However, these limitations would not prevent participation in RGGI or similar interstate trading programs, since these programs are premised on voluntary coordination where each state relies upon its own statutes and regulations and each state enforces its own requirements.

The APCA also includes a provision authorizing the DEP to cooperate with other states and interstate agencies to control and prevent air pollution, and "where appropriate formulate interstate air pollution control compacts or agreements for the submission thereof to the General Assembly." 35 PA. CONS. STAT. § 4004(24) (2011). Although this provision might be read to suggest that legislative authority is necessary before Pennsylvania could join an interstate trading program and adopt any necessary regulations to implement the program, it seems directed to agreements that are binding on the state and therefore require Congressional consent under the compacts clause of the U.S. Constitution. U.S. CONST. art. I, § 10 cl. 3. The trading regimes being independently implemented by states are implemented through a non-binding memorandum of understanding under which each state enacts and enforces its own laws and regulations, and therefore likely would not require Congressional approval under the Compacts Clause or require legislative approval under the APCA. *See* U.S. Steel Corp. v. Multistate Tax Comm'n, 434 U.S. 452, 470 (1978) (holding that creation of an "active administrative body" without Congressional consent did not "enhance the political power of the member States in a way that encroaches upon the supremacy of the United States" and therefore did not violate the Compacts Clause. The Court based its decision upon the following factors: (1) there were no features that, on their face, infringed on the supremacy of the United States; (2) the Compact did not authorize any of the member states to "exercise any powers they could not exercise in its absence"; (3) there was no "delegation of sovereign power to the Commission' and the states retained "complete freedom to adopt or reject the rules and regulations of the Commission"; and (4) each state was "free to withdraw at any time"); NE Bancorp v. Bd. of Governors of Fed. Reserve Sys., 472 U.S. 159 (1985).

316. *See* Reg'l Greenhouse Gas Initative, *Memorandum of Understanding*, ¶ G(1) (2005) ("25% of the allowances will be allocated for a consumer benefit or strategic energy purposes" as further defined

tions of emissions rights, a partial allowance auction has been implemented in Pennsylvania in the past, since the Title IV program under the federal Clean Air Act allocates some allowances by auction.[317]

More significantly, the *PEDF* decision suggests that an auction with a reserve price is constitutionally required to allow the beneficiaries of the trust to benefit from the program. As discussed below, allowances may be considered to represent ecosystem services in that they represent the limited remaining ability of the atmosphere to absorb additional GHG pollution without disruption. Because the revenues would derive from efforts to preserve the environmental trust, these revenues could be considered the result of the sale of renewable ecosystem services, similar to revenue from timber sales on state forest land. *PEDF* applied the law of trusts to invalidate a distribution of trust principal but recognized that trust income from renewable services that did not deplete the trust corpus could be moved to the General Fund.[318] The rule of prudence requires that a trustee manage a trust with the prudence that a reasonable person would manage his or her own affairs, considering the needs of beneficiaries, the need to preserve the corpus of the trust, and the amount and regularity of income.[319] Although this rule of prudence allows considerable discretion in managing a trust, it does not allow the trustee to give away either the principal or the income with no benefit to the beneficiaries or to favor one beneficiary over the other. Thus, the state auctions timber, minerals and other renewable and non-renewable resources produced by state forests. For this reason, an auction of GHG emissions allowances is not only authorized but arguably required in the absence of another rationale, such as preventing leakage.

VI. ISSUES RELATING TO POSSIBLE LIMITATIONS ON AWARD OF ALLOWANCES AND USE OF REVENUES

PEDF restricted the General Assembly's ability to direct lease revenues to the unrestricted general fund based on the Court's conclusion that the Pennsylvania Constitution required the principal of the environmental trust created by the ERA to be retained for the purposes set forth in the Constitution.[320] We have argued that *PEDF* restricts the Commonwealth's ability to award allowances without recovering income for the beneficiaries. We also have argued that the ERA both authorizes an auction with a reserve price based on the social cost of carbon and requires a mechanism that both limits GHG emissions to a level consistent with that

in the paragraph), https://www.rggi.org/sites/default/files/Uploads/Design-Archive/MOU/MOU_12_20_05.pdf.

317. 42 U.S.C. § 7651 (2012).

318. Pa. Envtl. Def. Found. v. Commonwealth, 161 A.3d 911, 935-36 (Pa. 2017).

319. RESTATEMENT (THIRD) OF TRUSTS § 90 (2007); *see also* Harvard Coll. v. Amory, 26 Mass (9 Pick) 446 (1830).

320. *See PEDF*, 161 A.3d at 934.

required to prevent climate disruption and provides reasonable income to the beneficiaries of the ERA's trust. In this section, we address the limits of these requirements with respect to GHG emissions allowances and proceeds from the auction or sale of those allowances.

The law of trusts does not put handcuffs on a trustee. Rather, it imposes a rule of prudence, requiring that a trustee manage a trust with the prudence that a reasonable person would manage his or her own affairs, considering the needs of beneficiaries, the need to preserve the corpus, the trust, and the amount and regularity of income.[321] Instead of being considered the proceeds from the liquidation of the principal of the trust, auction revenues are more properly considered to constitute income from measures to manage the trust corpus, much like income from sustainable harvest of timber. Therefore, the proceeds from these revenues can be used for any purpose, provided the use accrues to the benefit of the trust's beneficiaries.[322] Likewise, the trustee need not receive income equal to the social cost of carbon in all instances regardless of the outcome, but may award allowances for a lesser cost or even no cost where the Commonwealth, as a prudent business person, could conclude this would serve the best interest of the beneficiaries. For example, awarding allowances at a lower cost or no cost would be prudent where necessary to prevent leakage that would drive business from the Commonwealth without achieving a necessary reduction in GHG emissions. However, these situations should be treated as exceptions to the general rule and should be applied only as prudence demands.

A. *PEDF's Implications with Respect to Use of Revenues from GHG Emissions Auction*

Questions have arisen as to whether *PEDF* has implications with respect to potential mechanisms to put a price on carbon. Without additional legislation, proceeds from an auction would be deposited in the General Fund.[323] If *PEDF* restricts use of these revenues, the decision would remove a significant incentive for Pennsylvania to impose a price on carbon through an allowance auction. The proceeds of a carbon tax or auction could be used to promote a variety of important fiscal objectives.[324] In addition, the current and the on-going budget crisis in Pennsylvania has created a very significant incentive for the General Assembly to adopt legislation establishing a GHG emission fee or auction and trade program or to

321. RESTATEMENT (THIRD) OF TRUSTS § 90 (2007); *see also Harvard Coll.*, 26 Mass (9 Pick) 446.

322. *See* RESTATEMENT (THIRD) OF TRUSTS § 90 (2007); *see also Harvard Coll.*, 26 Mass (9 Pick) 446.

323. 72 PA. CONS. STAT. § 8 (1991).

324. *See* McKinstry et al., *supra* note 185, at 218-21.

allow the EQB's adoption of regulations establishing an auction, so as to generate revenue to fill the gap in the General Fund.[325]

PEDF should not restrict the use of revenues from a GHG auction. The analysis of this issue differs according to how one views the auction. In this regard, there are two ways of looking at the auction of allowances. On one hand, one can view the auction of allowances as a regulatory mechanism to reduce GHG emissions. On the other hand, one can view the auction of allowances as a charge for the sale of a public natural resource, either: (1) the air, (2) the limited capacity of the atmosphere to absorb GHG emissions without disrupting the climate, or (3) the costs that will be imposed on future generations from carbon dioxide emissions (*i.e.* "ecosystem services" — one of the natural values of the environment).[326] In both economic and legal theory, the auction has characteristics of both a regulatory mechanism and a charge. However, because differing legal and political considerations apply depending upon whether the fee/auction is characterized as a regulatory mechanism or as a fee for ecosystem services, we will address the considerations applicable to each rationale separately.

If the auction is examined through the regulatory lens, *PEDF* should have no impact on use of the revenues. An auction of allowances is simply one of several regulatory mechanisms to reduce emissions. In this way it is no different from a regulatory emission limit. Under this lens, the auction is a mechanism that acts to preserve the corpus of the trust created by the ERA. Its imposition is therefore consistent with the trustee's duty to preserve the corpus of the trust and there should be no restrictions on the use of revenues.

Characterizing the auction/fee as purely a regulatory measure, however, has both legal and political disadvantages. Treating the auction as purely a regulatory measure under the APCA might undermine the argument for an auction with a meaningful reserve price. The APCA lacks specific legislative authorization for an auction or a reserve price, so that regulations establishing an auction and a reserve price without further action by the General Assembly depend to some degree upon

325. Mary Soderberg & Josh Shapiro, *Pennsylvania In Peril: A Financial Crisis*, THE WOLF TRANSITION (Nov. 19, 2014), http://www.wolftransitionpa.com/sections/blog/pennsylvania-fiscal-crisis. Although this source was prepared immediately after Governor Wolf's election, the state of finances has not improved, and the budget continues to rely upon sales of assets and transfers that the Supreme Court in *PEDF* found illegal. *See* PA. OFFICE OF THE BUDGET, 2017-18 BUDGET IN BRIEF (2017), http://www.budget.pa.gov/PublicationsAndReports/CommonwealthBudget/Documents/2017-18%20Proposed%20Budget/2017-18%20Budget%20In%20Brief%20-%20Web.pdf.

326. Ecosystem services have been defined as "benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as regulation of floods, drought, land degradation, and disease; supporting services such as soil formation and nutrient cycling; and cultural services such as recreational, spiritual, religious and other nonmaterial benefits," including a stable climate. UNEP SECRETARIAT OF THE CONVENTION ON BIOLOGICAL DIVERSITY, BEST POLICY GUIDANCE FOR THE INTEGRATION OF BIODIVERSITY AND ECOSYSTEM SERVICES IN STANDARDS, CBD Technical Series No. 73 (2012), at 14, https://www.cbd.int/doc/publications/cbd-ts-73-en.pdf.

authorization under the ERA. Treating the auction as purely a regulatory mechanism may also undermine the argument that the reserve price should be set equal to the social cost of carbon rather than the far lower reserve prices seen in the California and RGGI programs, which are lower than the marginal cost necessary to prevent further climate disruption. Perhaps more significantly, characterizing the auction as a regulatory mechanism rather than the purchase of ecosystem services could be less palatable to those conservatives who support climate action. The conservative case for a carbon fee is based on the principle that GHG emitters should be charged a fee for the cost of the risk of environmental or other damage that will arise from use of the environment/ecosystem services, rather than the notion that regulation should be expanded.[327]

On the other hand, if one looks at the revenues from the GHG fee/auction as payments for ecosystem services, there is a risk that arguments will be raised that these revenues cannot be devoted to the General Fund to help address Pennsylvania's budget crisis but must be retained as part of the corpus of the ERA trust. Although there is a risk that this argument may be raised, close examination of the *PEDF* decision, and the facts presented there, suggest that this argument should not prevail. Even if this argument prevails, it would not require retention of all revenues or even any revenues.

The legislation at issue in *PEDF* diverted revenues that had been devoted to the maintenance of the corpus of the trust away from that purpose and impaired DCNR's ability to maintain parks and forests, which also constitute the corpus of the trust.[328] In contrast, the establishment of a GHG auction and generation of revenues would not divert any existing, similarly committed revenues away from the trust or impair the Commonwealth's ability to maintain and conserve public natural resources. It would instead create new revenues by a mechanism that would also maintain and conserve the corpus of the trust.

It should be noted that, even if the fee/auction is viewed as *both* a regulatory mechanism and the sale of a natural resource, the trustee should be entitled to distribute income to the beneficiaries as long as the revenue does not deplete or impair the trust corpus. In *PEDF*, the Commonwealth was selling non-renewable resources and depleting the corpus of the trust, which should not be depleted.[329] A GHG auction preserves the capital and produces the equivalent of dividend income. Since the application of the income will benefit the beneficiaries, that in-

327. *See, e.g.*, Marc Gunther, *Climate Converts: The Conservatives Who Are Switching Sides on Warming*, YALEENVIRONMENT360 (Mar. 30, 2017), http://e360.yale.edu/features/climate-converts-the-conservatives-who-are-switching-sides-on-climate-change; Jerry Taylor, *The Conservative Case for a Carbon Tax*, NISKANEN CTR. (Mar. 23, 2015), https://niskanencenter.org/wp-content/uploads/2015/03/The-Conservative-Case-for-a-Carbon-Tax1.pdf; Bob Litterman, *What is the Right Price for Carbon Emissions*, 36 REGULATION 38 (2013), https://object.cato.org/sites/cato.org/files/serials/files/regulation/2013/6/regulation-v36n2-1-1.pdf.

328. Pa. Envtl. Def. Found. v. Commonwealth, 161 A.3d 911, 937-39 (Pa. 2017).

329. *Id.*

come could go to the General Fund. In fact, because the social cost of carbon is set at the marginal cost/value of avoided future damage to trust resources, all revenues equal to the social cost of carbon come from measures to preserve the trust principal and can be considered income. As long as the principal is maintained, and income is provided for the benefit of the beneficiaries, the rule of prudence should be satisfied.

B. *PEDF's Implications with Respect to Award of Allowances*

We argue that allowances, as attributes of the environmental trust, should generally be auctioned, just as other sustainable products of the environmental trust should be auctioned. We also argue that the auction should include a reserve price based on the social cost of carbon to assure that the measures undertaken in response to the cap-and-trade program will include the measures necessary to prevent human-caused climate disruption. This does not require an ironclad rule. Under the rule of prudence applicable to trustees, certain exceptions may be appropriate to prevent or moderate leakage, while still preserving the corpus of the trust and producing a stream of income to the trust's beneficiaries.[330]

First, under the rule of prudence, in order to prevent leakage, Pennsylvania could allow distribution of allowances free of charge or at a reduced rate to industries subject to international or interstate competition where necessary to preserve those industries' international markets. Because the allowances will have a value equal to or greater than the reserve price in the auction, these industries will still have strong incentive to reduce emissions and rely on electricity rather than fossil fuels. However, they will be able to price their products competitively and they will no longer have an incentive to move their operations to a state or nation without regulation where those operations would result in leakage. This approach will need to be employed cautiously, so as to avoid perverse results.[331]

Second, it may be appropriate to provide for a lower reserve price initially if warranted to assure adequate long-term income. The RGGI and California-Quebec-Ontario programs all include significantly lower auction minimum reserve

330. *See* RESTATEMENT (THIRD) OF TRUSTS § 90 (2007); *see also* Harvard Coll. v. Amory, 26 Mass (9 Pick) 446 (1830).

331. For example, as discussed *supra* note 265, in industries outside the electricity sector with international markets (such as steel), it may be worthwhile to award free or reduced cost allowances based on the prior year's unit production, with the number of free allowances per unit of production decreasing over time. That approach would have perverse results, however, if it were applied to the electricity sector, since it would encourage production even where that production would increase overall emissions. In the electricity sector, an allowance would represent income and, if tied to production, would allow a lower bid, removing the incentive to switch dispatch away from units with higher emissions. Therefore, industry structure should be carefully assessed and exceptions to the general rule allowed only where strictly warranted.

prices,[332] as well as cost containment reserves that provide for the release of additional allowances if allowance prices exceed a value significantly lower than the social cost of carbon.[333] The proposed Virginia program closely follows RGGI.[334] If the Pennsylvania reserve price is set too high and trading is allowed, this may reduce the number of allowances that buyers will purchase from Pennsylvania, significantly depleting the income to be received by the trust beneficiaries. Therefore, Pennsylvania could initially establish a reserve price more consistent with California's reserve price. All of the other state trading programs call for reductions in the caps, increases in the reserve prices, and increases in the triggers for releasing cost containment reserves, such that the prices will approach the social price of carbon.[335] Moreover, because the social cost of carbon increases significantly if action imposing an adequate price on emissions is delayed;[336] accepting a lower price today will mean that the price to be paid eventually will be higher.[337] Thus, the rule of prudence provides the Commonwealth with flexibility.

VII. BLOCKING ACTION BY THE GENERAL ASSEMBLY PREVENTING IMPLEMENTATION OF GHG REGULATION

Perhaps the clearest implication of the *PEDF* and *Robinson Township* decisions is that Article I, § 27 may be relied upon to invalidate actions by the General Assembly aimed at blocking the implementation of regulations establishing meaning-

332. CAL. CODE REGS. tit. 17, § 95911(c) (2017); RGGI Model Rule § XX-1.2 (2017) (definition of "minimum reserve price"), https://rggi.org/sites/default/files/Uploads/Program-Review/12-19-2017/Model_Rule_2017_12_19.pdf.

333. CAL CODE REGS. tit. 17, § 95913 (2017); RGGI Model Rule §§ XX-1.2 (2017) (definition of "CO_2 cost containment reserve allowance or CO_2 CCR allowance"), XX-9.2(b), https://rggi.org/sites/default/files/Uploads/Program-Review/12-19-2017/Model_Rule_2017_12_19.pdf.

334. *See* Regulation for Emissions Trading Programs, *supra* note 243.

335. Arguably, the RGGI and California-Quebec-Ontario reserve prices are currently too low to drive necessary reductions, since the social cost of carbon is based on the economically efficient marginal cost of the damage averted. Because the allowance prices obtained in RGGI auctions have been insufficient even to prevent existing nuclear facilities from premature closure, New York promulgated regulations requiring that electricity distribution companies purchase ZECs based on the social cost of carbon from existing nuclear generation units to put a sufficient value on their emissions-free electricity. The New York Clean Energy Standard, upheld in *Coal. for Competitive Elec. v. Zibelman*, 272 F. Supp. 3d 554, 561 (S.D.N.Y. 2017), *appeal filed* (2d Cir. Aug. 25, 2017) (quoting CES Order, app. E, at 1), was designed to further New York's policy to reduce GHG emissions by preserving existing emissions free electricity provided by New York's nuclear plants and by encouraging the development of additional emissions-free electricity from renewable generation sources. It was motivated, in part, by the announcements that the Fitzpatrick and Ginna nuclear plants would close due to financial stresses caused by low electricity prices created by the oversupply of natural gas from shale gas resources, as well as by the failure of the RGGI prices to impose sufficient costs for CO_2 emissions from fossil-fired electricity generation. *Id.* at 562, n.5.

336. Daniel et al., *supra* note 327, at 38-39; *see also* Litterman, *supra* note 331; Litterman, Daniel & Wagner, *supra* note 218, at 43.

337. Increasing prices in later years, when there is a lower cap, will help maintain total revenues.

ful limits on GHG emissions. The General Assembly can exercise a variety of powers to attempt to block the adoption of regulations limiting emissions of GHGs and having the effect of putting a price on those emissions.[338] The General Assembly could also seek to block those regulations through its appropriations power or by adopting legislation repealing the regulations and removing the EQB's authority to regulate.

Robinson Township invalidated legislation that removed powers from municipalities and the DEP that allowed those municipalities and the DEP to exercise their duties as trustees.[339] *PEDF*'s holding makes it clear that the Commonwealth's duty as a trustee applies to all types of actions, including appropriations. *PEDF* could be relied upon to invalidate the General Assembly's action, just as the transfer of funds through the budget process was invalidated in *PEDF*. Even the *Funk* decision recognized that the ERA could be used to invalidate legislation that impaired rights guaranteed by the ERA.[340]

Legislation blocking a regulation required to "maintain and conserve" a stable climate, repealing such a regulation, replacing a regulation with a weaker version that did not maintain and conserve a stable climate, or removing the power to regulate GHGs from the EQB would all likely be unconstitutional violations of the ERA under the reasoning in *PEDF* and *Robinson Township*.

CONCLUSION

The precise contours of Article I, § 27 rights, enunciated in *Robinson Township* and *PEDF*, as they relate to GHG regulation and emissions pricing have not been litigated. Nevertheless, those opinions provide substantial support both for meaningful regulation of GHG emissions by Pennsylvania and for a regulated emissions

338. For example, the General Assembly might adopt legislation such as the Pennsylvania Greenhouse Gas Regulation Implementation Act, 71 PA. CONS. STAT. §§ 1362.1-1362.4 (2014), where the General Assembly required legislative review of Pennsylvania's submission of its implementation plan for the Clean Power Plan. Unless the Act is construed to make it constitutional, it provides a possible mechanism for an unconstitutional one-house veto of the plan. *See* PA. CONST. art. I, § 27 (stating that Pennsylvania's natural resources are a public trust), art. IV, §§ 9, 15 (requiring passage of laws, resolutions and votes by both houses and presentment to the governor); Commonwealth v. Sessoms, 516 Pa. 365, 532 A.2d. 775 (1987) (invalidating legislative veto); MCT Transp., Inc. v. Phila. Parking Auth., 60 A.3d 899 (Pa. Commw. Ct. 2013) (holding that approval of a rule under a similar procedure did not constitute valid legislative action consistent with separation of powers principles and specifically disapproving of the process as a one-house veto). The General Assembly might also attempt to invalidate a regulation pursuant to the process prescribed in the Regulatory Review Act, 71 PA. CONS. STAT.§§ 745.1–745.15 (1982).

339. Robinson Twp. v. Commonwealth, 83 A.3d 901, 977-85 (Pa. 2013).

340. *Funk* cited *Cmty. Coll. of Delaware Cty. v. Fox*, 20 Pa. Commw. 335, 342 A.2d 468, 473 (1975) for the proposition that the ERA "could operate *only to limit such powers as had been expressly delegated by proper enabling legislation*." Funk v. Wolf, 144 A.3d 228, 249 (Pa. Commw. Ct. 2016), *aff'd without opinion*, 158 A.3d 642 (Pa. 2017) (emphasis in *Funk*).

price sufficient to put the Commonwealth on a path to deep decarbonization and economic modernization.

If these decisions are extended to support an Article I, § 27 mandate to regulate GHGs as suggested here, that extension can also have national and international significance. Many states and nations have similar provisions in their constitutions or public trust doctrines, and the scholarly constitutional jurisprudence of the Pennsylvania Supreme Court may be persuasive to these other jurisdictions.