PRICING SOLAR DEVELOPMENT OPTIONS

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INTRODUCTION

I see the sun, and if I don't see the sun, I know it's there. And there's a whole life in that, in knowing that the sun is there.
—Fyodor Dostoevsky[1]

The time to repair the roof is when the sun is shining.
—John F. Kennedy[2]

Since the 1980s, each decade has been warmer than the last.[3] The nine years from 2014 through 2022 were the nine warmest years on record.[4] The results of these temperature trends are familiar at this point: Ice sheets are shrinking. Glaciers are retreating at an increasing rate. Sea levels are rising. Ocean acidification is intensifying.[5] As climate change progresses, the Earth will experience worse flooding, harsher droughts, and more severe hurricanes.[6] Yet, there is still time to mitigate the worst impacts of climate change—time to repair the roof.

And there is reason for hope. The Inflation Reduction Act (IRA) of 2022 has prompted an unprecedented surge in solar energy investment.[7] In the coming years, as funding pours into solar development as a result, solar power

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1. FYODOR DOSTOEVSKY, THE BROTHERS KARAMAZOV 639 (Constance Garnett trans., 1922) (1880).

2. President John F. Kennedy, Annual Message to the Congress on the State of the Union (Jan. 11, 1962), https://www.presidency.ucsb.edu/documents/annual-message-the-congress-the-state-the-union-4 [perma.cc/U6LL-C2NV].

3. Rebecca Lindsey & Luann Dahlman, *Climate Change: Global Temperature*, NAT'L OCEANIC AND ATMOSPHERIC ADMIN. (Jan. 18, 2023), https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature [perma.cc/6F2X-SFPW].

4. *Id.*

5. Courtney Lindwall, *What Are the Effects of Climate Change?*, NAT'L RES. DEF. COUNCIL (Oct. 24, 2022), https://www.nrdc.org/stories/what-are-effects-climate-change [perma.cc/W7T7-EMYF].

6. *Id.*

7. *See, e.g.*, Jack Ewing & Ivan Penn, *Clean Energy Projects Surge After Climate Bill Passage*, N.Y. TIMES (Sept. 7, 2022), https://www.nytimes.com/2022/09/07/business/energy-environment/clean-energy-climate-bill.html [perma.cc/8Y7M-H9A5].

will play an increasingly important role in the energy sector.[8] However, to fully exploit the IRA's benefits—and thus maximally abate climate change—state legislatures must address a fundamental and persistent impediment to solar development: inadequate solar access rights.[9] This impediment is particularly problematic in dense urban areas, where prospective solar users face the risk that rapid vertical development could block their sunlight access.[10] The issue is further pressing because, absent this problem, urban rooftop solar may be "an effective means to solve urban energy requirements and environmental issues."[11] And herein lies the impetus for this Essay.

In 2019, Joshua Landis offered a novel approach to this problem.[12] He proposed the creation of solar development options (SDOs), which provide a mechanism for protecting solar rights and incentivizing solar development utilizing transferable development rights (TDRs) and call options.[13] While Landis's proposal has certain deficiencies—which this Essay will explore—SDOs nevertheless have the potential to transform solar access regimes in urban areas. Moreover, their economic success in one city could mean their adoption more broadly, including outside the U.S.[14] However, SDOs have garnered virtually no attention since Landis proposed the concept.[15] Accordingly, this Essay aims to spark discussion on how to put this fledgling idea into practice.

This Essay proceeds in three parts. Part I outlines the basic evolution of solar rights leading up to Landis's proposal of SDOs and illustrates the need for state legislative reform. Part II then describes Landis's proposal and explains the concepts undergirding SDOs—i.e., TDRs and call options. Part II also explores the advantages of SDOs as well as the problems with Landis's

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8. *See* Mickey Francis & Manussawee Sukunta, *Solar Generation Was 3% of U.S. Electricity in 2020, but We Project It Will Be 20% by 2050*, U.S. ENERGY INFO. ADMIN. (Nov. 16, 2021), https://www.eia.gov/todayinenergy/detail.php?id=50357 [perma.cc/CQB6-47J9].

9. *See* Sara C. Bronin, *Solar Rights*, 89 B.U. L. REV. 1217, 1219, 1251 (2009).

10. *See* Emily Badger, *In the Shadows of Booming Cities, a Tension Between Sunlight and Prosperity*, WASH. POST (May 4, 2015, 6:55 PM), https://www.washingtonpost.com/news/wonk/wp/2015/05/04/in-the-shadows-of-booming-cities-a-tension-between-sunlight-and-prosperity [perma.cc/M4JU-TWDN] (highlighting tensions between solar energy and vertical development).

11. *Cf.* Zhaojian Huang, Thushini Mendis & Shen Xu, *Urban Solar Utilization Potential Mapping via Deep Learning Technology: A Case Study of Wuhan, China*, 250 APPLIED ENERGY 283, 283 (2019).

12. Joshua B. Landis, Note, *Sunny and Share: Balancing Airspace Entitlement Rights Between Solar Energy Adopters and Their Neighbors*, 72 VAND. L. REV. 1075, 1103 (2019).

13. *Id.*

14. To the extent that SDOs may make a nontrivial difference in efforts to combat global climate change, this is crucial.

15. The author could find only one passing reference to SDOs in an external source. *See* JON W. BRUCE, JAMES W. ELY, JR. & EDWARD T. BRADING, THE LAW OF EASEMENTS AND LICENSES IN LAND § 12:4 (2d ed. 2023).

framework. Finally, Part III proposes a new framework for SDOs and illustrates how this updated approach is more economically efficient as well as more effective at incentivizing solar development.

I. EVOLUTION OF SOLAR RIGHTS

Despite the economic value of sunlight, the right to access it remains underprotected. At common law, there is hardly any protection for solar rights.[16] Additionally, where solar rights are recognized through state legislation, "they are often so burdensome or expensive to obtain that property owners may not bother seeking them."[17] Nonetheless, it is *possible* to protect one's sunlight access. This Part explores the history of solar rights in two ways. First, Section I.A describes how today's scant common law solar rights developed. Section I.B then provides an overview of state legislative efforts to protect solar rights and explains why such efforts are yet inadequate.

A. *Common Law Solar Rights*

Under the English common law doctrine of "ancient lights," a landowner who enjoyed unobstructed access to sunlight through their window for at least twenty years was entitled to an easement guaranteeing continued access.[18] However, United States courts have long rejected the doctrine as incompatible with the goal of promoting development.[19] Consequently, the only common law option for landowners seeking to protect their sunlight access from interference by neighbors is private nuisance law.[20]

Under the Restatement (Second) of Torts, a private nuisance is the "nontrespassory invasion of another's interest in the private use and enjoyment of land."[21] At first glance, obstruction of sunlight does not fall neatly into this definition. Unlike noises and odors, obstructing another's sunlight is not a literal physical invasion. Even conceptualizing sunlight obstruction as "casting a shadow," the obstruction merely *prevents* photons from invading another's property. In other words, since a shadow is the absence of light, it cannot itself be considered an invasion in the physical sense. Accordingly, before 1982, no

16. Sara C. Bronin, *supra* note 9, at 1251.

17. *See* Sara C. Bronin, *Modern Lights,* 80 U. COLO. L. REV. 881, 883 (2009).

18. *Ancient-Lights Doctrine*, BLACK'S LAW DICTIONARY (11th ed. 2019). In contrast to an affirmative easement, which grants a right of entry to land, a negative easement precludes a landowner from doing something. 25 AM. JUR. 2D *Easements and Licenses* § 7 (2022).

19. Fontainebleau Hotel Corp. v. Forty-Five Twenty-Five, Inc., 114 So. 2d 357, 359 (Fla. Dist. Ct. App. 1959); *see* Prah v. Maretti, 321 N.W.2d 182, 188 (Wis. 1982). At least one state has expressly rejected the doctrine by statute. W. VA. CODE ANN. § 2-1-2 (2022) ("The common law of England in regard to ancient lights is not in force in this state.").

20. *See* Bronin, *supra* note 9, at 1251.

21. RESTATEMENT (SECOND) OF TORTS § 821D (AM. L. INST. 1979).

court had found that obstructing sunlight from reaching a neighbor's solar collectors amounted to a private nuisance.[22]

However, in 1982, the Wisconsin Supreme court recognized, in *Prah v. Maretti*, a private nuisance action for sunlight obstruction.[23] In reaching its conclusion, the majority cited comments from the Restatement that "the phrase 'interest in the use and enjoyment of land' as used in [this Restatement] is broadly defined," and that "[f]reedom from discomfort and annoyance while using land is often as important to a person as freedom from physical interruption."[24] Next, the court noted that while United States courts had rejected the doctrine of ancient lights, courts had recognized nuisance actions in cases of malicious obstruction of sunlight involving "spite fences."[25] Further, the court argued that the policy reasons for limiting the application of private nuisance to the narrow category of spite fences were no longer applicable.[26]

Despite its forceful arguments, *Prah* has ultimately been unimpactful in protecting solar access rights, as most states still recognize the traditional rule that obstruction of sunlight is not a private nuisance absent malice.[27] Moreover, commentators view *Prah* as an outlier case and a departure from previous court decisions.[28] Indeed, it is unlikely that private nuisance will become a viable way to protect against solar interference from neighbors.[29]

In any case, even if nuisance law were to evolve such that it reflected the holding in *Prah*, it would nevertheless be an inefficient way to allocate solar rights. The Coase Theorem suggests that when a legal rule clearly assigns an entitlement to one of two parties, the parties will bargain so that the entitlement always ends up in the hands of the party who values it more.[30] Thus, in the case of an airspace entitlement—and assuming zero transaction costs for the moment—if the law clearly assigns the entitlement to either the solar user or the neighbor, the system will be efficient irrespective of who holds the initial entitlement. For example, if the solar user holds the initial airspace entitlement over their neighbor's house, but the neighbor wants to build an addition that would block the solar user's collectors, the neighbor can pay the solar user for

22. Bronin, *supra* note 9, at 1252.

23. *Prah*, 321 N.W.2d at 191.

24. *Id.* at 187 (quoting RESTATEMENT (SECOND) OF TORTS, § 821D cmt. b (AM. L. INST. 1979)).

25. *Id.* at 188 (citing spite-fence cases in which defendants had constructed fences out of malice).

26. Specifically, the court argued that (1) "society ha[d] increasingly regulated the use of land by the landowner," (2) "access to sunlight ha[d] taken on a new significance" given the advent of solar collectors, and (3) "the policy of favoring unhindered private development" had lost force since the days of rapid national expansion. *Id.* at 189–90.

27. JAMES CHARLES SMITH, LAW OF NEIGHBORS § 5:6 (2022).

28. *See, e.g.*, Dean N. Alterman, Comment, *Reflected Sunlight Is a Nuisance*, 18 ENV'T L. 321, 337 (1988).

29. Bronin, *supra* note 9, at 1256.

30. *See generally* R.H. Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1 (1960).

the right to build the addition.[31] But they will only do so if they value the airspace more than the solar user. Similarly, if the neighbor holds the entitlement, the solar user can pay the neighbor *not* to obstruct their sunlight, allowing them to install solar panels without risking that the panels become obsolete at the whim of their neighbor.

However, the rule asserted in *Prah*—that the neighbor is subject to liability if their development unreasonably invades the solar user's interest in the use and enjoyment of land—does not clearly assign an entitlement.[32] Under the *Prah* rule, whether a solar user has the right to unobstructed sunlight depends on whether the neighbor's construction is a nuisance. And settling that fact-intensive inquiry requires litigation, a notoriously slow and inefficient process.[33] Accordingly, common law solar rights are insubstantial and likely to stay that way.

B. *Express Solar Easements*

Given the common law's ineffectiveness at protecting solar rights, many states allow solar users to protect their sunlight access by contracting for express solar easements.[34] A solar easement protects a solar user's right to access direct sunlight passing through a servient landowner's airspace.[35] Therefore, a solar easement prevents the servient estate from building in such a way that interferes with the solar user's access to direct sunlight (which would impair the effectiveness of their solar collectors).[36]

In theory, statutes allowing for the creation of solar easements might seem highly beneficial.[37] As an initial matter, express solar easements are fair, as both parties involved voluntarily agree to the easement based on an arm's length bargain. Additionally, easements provide strong protection for solar users because they are perpetual in nature.[38] However, as beneficial as solar easement statutes are in theory, they pose problems for solar developers due to the transaction costs involved in bargaining.[39]

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31. Similarly, if a tree in the neighbor's yard grows and blocks the solar user's panels, the neighbor could pay the solar user for the right to leave the tree standing.

32. Carol M. Rose, *Crystals and Mud in Property Law*, 40 STAN. L. REV. 577, 579 (1988) (pointing out that under *Prah*'s rule, the neighbor cannot know in advance whether their construction will be a nuisance).

33. *See* Bronin, *supra* note 9, at 1251 (noting that "even if courts were receptive to solar rights theories, litigation will remain perhaps the least efficient and most expensive method of resolving solar rights").

34. *See id.* at 1225–26; K.K. DuVivier, *Solar Skyspace B*, 15 MINN. J.L. SCI. & TECH. 389, 403 (2014) ("Thirty states permit property owners to create a solar easement through contract.").

35. *See Solar Easement*, BLACK'S LAW DICTIONARY (11th ed. 2019).

36. *Id.*

37. Bronin, *supra* note 9, at 1226–28.

38. *Id.* at 1228.

39. *Id.* at 1229.

Given the lack of impact of *Prah*, the initial entitlement to the airspace above a property is, by default, assigned to the owner of that property—i.e., the neighbor, not the solar user. In a world of zero transaction costs, that would not be an issue. Whenever efficient, one would expect the solar user to pay the neighbor for a solar easement. However, due to heavy transaction costs, express easements will be created less often than efficiency demands.[40]

At least one state, Iowa, attempts to address this problem by empowering local "solar access regulatory boards" to unilaterally create solar easements (subject to certain constraints) when solar users are unable to successfully negotiate for voluntary solar easements with their neighbors.[41] One constraint is the statute's requirement that the solar user compensate the burdened landowner for the fair market value of the airspace.[42] This mandate ensures that, as long as the market valuation is accurate, a solar developer will only compel the sale of an easement when they value the airspace more than the market.[43]

However, Iowa's law still falls short in two key respects. First, the perpetual nature of the easements created under Iowa's statute "limits the flexibility of future land use planning."[44] In essence, perpetual easements risk overprotecting solar rights at the expense of other, potentially more beneficial, development. In response, commentators have suggested restrictions on easement duration.[45]

Second, Iowa's requirement that the solar user compensate the servient owner may make acquiring a solar easement cost prohibitive. As Landis observed, "recent evidence" of Iowans creating easements under the statute "is noticeably hard to come by."[46] Additionally, while addressing the first problem (by instituting temporary easements) would lessen the solar user's cost (since temporary easements cost less than perpetual ones), doing so would also shorten the available period during which the solar user could recoup their costs. Thus, merely instituting temporary easements would likely be insufficient to spur creation of solar easements—though it is technically an empirical question. Nonetheless, there is a strong argument that reform efforts should address both shortcomings.

For that reason, Landis proposed the creation of SDOs.[47] Much like the Iowa statute, an SDO system would allow a local agency to unilaterally grant

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40. In 2009, Professor Bronin stated that "a search of federal and state cases revealed not a single case dealing with express solar easements." *Id.* While express easements are surely underutilized, such cases dealing with express solar easements do now exist. *See, e.g.*, Bank of Akron v. Spring Creek Athletic Club, Inc., 151 A.D.3d 1864, 1864–65 (N.Y. App. Div. 2017) (holding that mortgages were "prior in time and right" to the airspace above the mortgagors' properties because they were given before defendant's solar easements were granted and recorded).

41. IOWA CODE § 564A.4 (2023).

42. *See id.* § 564A.5.

43. *See* Troy A. Rule, *Airspace in a Green Economy*, 59 UCLA L. REV. 270, 314 (2011).

44. Landis, *supra* note 12, at 1101.

45. *Id.*

46. *Id.* at 1102. Like Landis, the author was unable to find any such evidence.

47. *See generally* Landis, *supra* note 12.

a solar easement.[48] However, rather than require the solar user to compensate their neighbor, the municipality would grant the burdened landowner an allotment of "transferable development rights that could be sold to developers for use in specially designated receiving areas."[49] Further—and most uniquely—the burdened landowner would also receive a "call option," which, if exercised, would allow them "to remove the easement for a set price and reclaim [their] airspace rights."[50] Landis's proposal comes with significant advantages over Iowa's model, which Part II will explore in depth.

II. SOLAR DEVELOPMENT OPTIONS

This Part illustrates the advantages of Landis's proposal as well as its shortcomings. First, Section II.A explains the concepts undergirding SDOs—i.e., transferable development rights and call options. Next, Section II.B describes Landis's SDO framework and explores its advantages over Iowa's model and other solar access regimes. Finally, Section II.C identifies and discusses several important weaknesses in Landis's SDO proposal.

A. *Transferable Development Rights and Call Options*

TDRs are the first essential feature of SDOs. In essence, a TDR is a tool that allows a property owner in one location (the sending area) to sell their unused development rights to a property owner in another location (the receiving area).[51] In certain situations, a municipality may wish to restrict a landowner's ability to develop their property even though applicable zoning laws would allow such development. In such a case, the municipality can compensate the landowner by granting them TDRs. In turn, the landowner can sell those TDRs to a developer in a specified receiving area, allowing that developer to build beyond the applicable zoning requirements.[52]

In New York City, TDRs are often used for landmark preservation because there are strong incentives for landowners to tear down historic landmarks to

48. *Id.* at 1078.

49. *Id.* It should be noted that while the use of call options is unique to Landis's approach, other commentators have suggested compensating servient owners with TDRs. *See, e.g.*, Bronin, *supra* note 17, at 916–19 (proposing a TDR solar regime to compensate burdened landowners in urban areas).

50. Landis, *supra* note 12, at 1078.

51. Samantha Peikoff Adler, Note, Penn Central *2.0: The Takings Implications of Printing Air Rights*, 2015 COLUM. BUS. L. REV. 1120, 1131 (2015).

52. Christopher Serkin, Penn Central *Take Two*, 92 NOTRE DAME L. REV. 913, 918 (2016).

make space for new development.[53] However, the city has used TDRs for various purposes, including to create and protect affordable housing.[54] Indeed, TDRs are so versatile because they are relatively inexpensive and easy to implement.[55] Of course, there are also issues with TDRs—which this Essay will address—including, most importantly, whether TDRs qualify as "just compensation" under the Fifth Amendment's Takings Clause.[56]

Call options are the second essential feature of SDOs. In the corporate securities context, a "call option" allows the holder to purchase a stock at a predetermined "strike price" at some point in the future.[57] However, the idea has broader applicability. Landis points out that even though Iowa's law minimizes transaction costs, it still leaves open the possibility of inefficient transfers of airspace rights.[58] For instance, even though the servient owner will be compensated for the *market* value of their development rights under Iowa's law, it is possible that they value their airspace idiosyncratically.[59] In such a case, where the servient owner possesses an unusually high valuation of their airspace, the entitlement may not end up with the highest value user. The SDO approach addresses this problem by granting the servient owner a call option, which allows them to regain the airspace right at a strike price.[60]

B. *Improving Solar Access Regimes with Solar Development Options*

Having outlined the underpinnings of the SDO framework—TDRs and call options—this Section explains Landis's approach to SDOs and its advantages. First, like Iowa's system, "an SDO regime would vest a local body with the power to unilaterally grant a solar easement after weighing the necessity and reasonableness of the request."[61] As with Iowa's approach, parties would attempt to bargain over the easement before turning to the government.[62] However, unlike Iowa's system, "the solar easement in the SDO system

53. *See* N.Y.C. DEP'T OF CITY PLAN., A SURVEY OF TRANSFERABLE DEVELOPMENT RIGHTS MECHANISMS IN NEW YORK CITY 9 (2015), https://www.nyc.gov/assets/planning/download/pdf/plans-studies/transferable-development-rights/research.pdf [perma.cc/FZ89-W3X6].

54. *See id.* at 3; *Administration Releases Housing New York*, N.Y.C. HOUS. DEV. CORP. (Dec. 29, 2021), https://www.nychdc.com/newsroom/administration-releases-housing-new-york-final-report [perma.cc/7NF3-TSXH].

55. Serkin, *supra* note 52, at 931.

56. U.S. CONST. amend. V; *see* Note, *The Unconstitutionality of Transferable Development Rights*, 84 YALE L.J. 1101, 1110–11 (1975).

57. WILLIAM T. ALLEN, REINIER KRAAKMAN & VIKRAMADITYA S. KHANNA, COMMENTARIES AND CASES ON THE LAW OF BUSINESS ORGANIZATION 377 (6th ed. 2021).

58. Landis, *supra* note 12, at 1106.

59. *Id.* at 1106–08.

60. *Id.*

61. *Id.* at 1108.

62. *Id.* at 1108 n.201. Whether such a bargaining requirement would be beneficial is open to question. Three issues come to mind as an initial matter: (1) transaction costs; (2) the empirical questions of whether and to what extent potential beneficiaries of solar easements would

would automatically terminate after a predetermined number of years."[63] Given a typical solar payback period of six to eight years, Landis suggests that fifteen to twenty years would be a reasonable easement duration.[64] Opting for temporary easements as opposed to perpetual ones would serve the purpose of avoiding overprotecting solar access.

As in the Iowa law, the SDO approach requires compensation of the burdened landowner. However, the SDO system takes a unique approach that reduces costs for the solar user while simultaneously attempting to provide fairer compensation to the servient owner. To start, SDOs "move the responsibility for compensation from the solar adopter to the municipality."[65] The municipality would then award the burdened property owner an allotment of TDRs "equivalent in value to the property's lost development potential."[66] This compensation system has two immediate benefits: First, it lowers the cost (potentially significantly) of the solar project because the developer does not pay anything for the easement.[67] Second, it eliminates the transaction costs associated with the actual transfer of assets between the developer and the burdened property owner.

Under a perpetual easement system, "the TDR package [would] account for the property's permanent diminution in value."[68] However, an SDO system using temporary easements would value the easement using the rental return method, wherein "the TDR allotment can be conceptualized as an aggregated upfront payment reflecting the 'rent' for the duration of the easement."[69]

Next, in addition to the TDR allotment, the burdened landowner would receive a call option that would give the burdened party the right "to reclaim the airspace entitlement at a predetermined strike price."[70] This strike price would include "the total amount invested in the solar collection device, less the value of the attributable energy savings."[71] In other words, the strike price would compensate the solar developer the amount they have not yet recouped through energy savings. Thus, the strike price would decrease over time.

The strike price would also increase by "the value of the TDRs attributable to the posttermination period."[72] In essence, this provision prevents a windfall

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adhere in good faith to a bargaining requirement; and (3) how solar access regulatory boards would be expected to evaluate such bargaining.

63. *Id.* at 1108.

64. *Id.*

65. *Id.*

66. *Id.* at 1109.

67. "[T]he creation of easements does not come free: to require the purchase of an easement over neighboring property is to add greatly to the expense of installing a solar unit." Comment, *The Allocation of Sunlight: Solar Rights and the Prior Appropriation Doctrine*, 47 U. COLO. L. REV. 421, 432 (1976).

68. Landis, *supra* note 12, at 1109.

69. *Id.*

70. *Id.*

71. *Id.*

72. *Id.* at 1110.

for the burdened property owner who elects to exercise the call option. Under the rental return method for allocating TDRs, the burdened property owner is given an *upfront* allotment of TDRs representing the rent for the full duration of the easement, say twenty years. At the outset, then, they essentially receive payment of twenty years' rent in the form of TDRs. If the landowner exercises the call option after only ten years, though, they have only "earned" half of those TDRs. They would thus be overcompensated. The property owner could "realize the full development of her airspace and also reap the benefits from selling TDRs that were awarded to offset a burden she never actually bore."[73]

Therefore, the strike price must increase "so that the net compensation paid . . . reflects only the time during which the easement was in effect."[74] Of course, if any "unearned" TDRs have not been sold, the burdened property owner could simply return them to the municipality—the strike price would thus only increase by the value of unearned *and* unreturned TDRs.[75] Under this system, unless the burdened property owner has a feasible development opportunity for their own airspace, their incentive is to sell the full TDR allotment and never exercise the call option.[76]

The SDO framework Landis proposed comes with several advantages over Iowa's model. First, it can be applied in urban areas. Iowa's requirement that the solar user pay market value for the airspace entitlement would preclude most urban solar projects from getting off the ground. The enormous cost of purchasing airspace in a city like New York would almost certainly render it impossible for a developer to recoup their initial investment. An SDO regime, in contrast, assigns the compensation duty to the municipality, thus avoiding the problem entirely. And although an SDO regime would be a greater administrative burden than Iowa's regime—since the municipality would be responsible for allocating TDRs—these additional costs would not necessarily be prohibitive. Numerous "municipalities already have some form of a TDR regime in place, which w[ould] reduce the administrative costs" associated with initiating and sustaining an SDO program.[77]

Second, SDOs promote land-use flexibility. Under Iowa's liability rule, the perpetual nature of the easements paired with the lack of call option for the encumbered landowner prevents the possibility of terminating the easement at a reasonable price, even where the encumbered neighbor could put their airspace to more beneficial use than the solar developer. The SDO system would "not only cap the easement's duration but also promote early termination if an economically preferable option arises."[78] Assuming effective pricing

73. *Id.*

74. *Id.*

75. *Id.* An SDO system could also mandate the return of unsold TDRs. *Id.* at 1110 n.213.

76. *Id.* at 1110–11.

77. *Id.* at 1111; *see, e.g.*, *TDR Updates*, SMARTPRESERVATION, https://smartpreservation.net/tdr-updates [perma.cc/J2DE-NR55].

78. Landis, *supra* note 12, at 1112.

for the call option, the SDO system thus avoids overprotecting solar rights at the expense of beneficial development and promotes efficiency.[79]

Finally, municipalities can adapt the SDO system to further their environmental and sustainability goals.[80] For instance, "receiving areas could be used to encourage the development of other green projects—such as large-scale solar installations—that current zoning restrictions" would otherwise foreclose.[81] Alternatively, municipalities could elect to attach certain conditions to TDRs that specify, for example, energy efficiency requirements for construction projects undertaken using solar TDRs.[82]

C. *Problems with Solar Development Options*

Despite the advantages of SDOs, they are not impervious to critique. At the outset, there are two constitutional concerns with SDOs. First, there is an argument that an SDO system would violate the "just compensation" requirement of the Fifth Amendment's Takings Clause because servient owners would be compensated with TDRs rather than cash.[83] However, this is not a concern unique to SDOs, but a common concern among all TDR compensation systems. The Supreme Court has not provided a clear answer on whether TDRs are just compensation, but the Court's language in *Penn Central Transportation Co. v. City of New York* suggests that TDRs can at least allow a property restriction to avoid classification as an unconstitutional taking.[84]

In *Penn Central*, the Court held that the New York City Landmarks Preservation Commission had not effected an unconstitutional taking where the commission refused to permit the construction of a fifty-story office building above Grand Central Terminal, a historic landmark.[85] Notably, the City of New York had granted Grand Central's owners an allotment of TDRs upon the terminal's designation as a landmark.[86] In evaluating whether a taking had occurred, the Court balanced three factors: (1) "[t]he economic impact of the regulation on the claimant"; (2) "the extent to which the regulation has interfered with distinct investment-backed expectations"; and (3) "the character of the governmental action."[87] The Court determined that the grant of TDRs was

79. *Id.* at 1112–13.

80. *Id.* at 1113.

81. *Id.*

82. *See id.* (suggesting that receiving areas be used for large-scale solar projects that might not otherwise be possible).

83. U.S. CONST. amend. V.

84. *Cf.* Penn Cent. Transp. Co. v. City of New York, 438 U.S. 104, 137 (1978) (stating that TDRs "undoubtedly mitigate whatever financial burdens the law has imposed . . . and, for that reason, are to be taken into account in considering the impact of regulation").

85. *See id.* at 137–8.

86. *Id.* at 150.

87. *See id.* at 124.

relevant to the first factor, stating that the TDRs "undoubtedly mitigate whatever financial burdens the law ha[d] imposed . . . and, for that reason, [we]re to be taken into account in considering the impact of regulation."[88]

Thus, whether TDRs constitute "just compensation" may be a moot issue, as the appropriation of airspace rights through a TDR program seems to avoid classification as a taking in the first place.[89] Moreover, if the issue ever *becomes* relevant because TDRs are deemed *not* to qualify as "just compensation," SDOs (and other TDR systems) could still survive: municipalities would simply need to award servient owners cash and then sell the equivalent value of TDRs themselves on the market.

The second constitutional question is whether the creation of a solar easement represents a "public use" under the Takings Clause. Again, this problem is not unique to SDOs, as the same concern applies to Iowa's solar easement law. However, the Supreme Court takes a broad view of the phrase "public use."[90] Thus, although SDOs only confer direct benefits on solar users, SDOs may satisfy the "public use" requirement due to the public interest in fighting climate change.[91]

Moreover, if Iowa's law were ever struck down for failing the "public use" requirement, that would not sound the death knell for SDOs. While SDOs in their simplest form might not serve a clearer public use than the Iowa law, SDOs (and any TDR system for that matter) can be structured such that the receiving areas must be put to particular public uses, such as large-scale clean energy projects.

Alongside the constitutional concerns common among TDR systems, Landis's SDO framework also presents an incentive problem. To be sure, the framework has significant advantages. As Landis puts it, his SDO proposal "improve[s] upon existing solar access proposals and better address[es] the needs of solar adopters by focusing on urban centers, balancing competing rights against cost constraints, and preserving land use flexibility."[92] However, Landis overlooks the goal of optimizing incentives for potential solar developers. An ideal SDO system accomplishes the goals Landis outlines while minimizing the risk of inefficient *underdevelopment* of solar energy.

One way to prevent underdevelopment would be to lengthen the duration of the solar easement. This would provide greater protection for solar rights, thereby increasing incentives to enter SDO transactions.[93] However, this is not

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88. *Id.* at 137.

89. *But see id.* at 149–50 (Rehnquist, J., dissenting) (implying that in the takings analysis, TDRs are only relevant to the question of "just compensation"); Suitum v. Tahoe Reg'l Plan. Agency, 520 U.S. 725, 747 (1997) (Scalia, J., concurring) (noting that TDRs are "*new* right[s] conferred upon the landowner in exchange for the taking, rather than a *reduction* of the taking").

90. *See* Kelo v. City of New London, 545 U.S. 469, 484 (2005) (reasoning that the "public use" requirement is broad enough that economic development satisfies the requirement).

91. Landis, *supra* note 12, at 1112.

92. *Id.* at 1111.

93. *Cf.* Bronin, *supra* note 9, at 1228 (noting that an advantage of express solar easements for solar users is their irrevocability).

to imply, necessarily, that a perpetual easement is the proper solution. The question is what easement duration strikes the appropriate balance between incentivizing solar development and preventing overdevelopment at the expense of other beneficial uses of airspace.

Certainly, Landis recognized that solar developers need an incentive beyond merely the expectation of breaking even. He cites authority that the average time to break even on a solar project is six to eight years while he simultaneously suggests fifteen to twenty years as an adequate easement duration.[94] However, the problem with a fifteen-year easement (or even a twenty-year easement) is that modern solar panels typically last around twenty-five years.[95] By creating easements shorter in duration than the lifespan of a solar panel, a municipality would leave potential clean energy on the table. Perhaps a fifteen-year duration can be justified, to some extent, on the grounds that it combats the concern of entrenching solar rights. However, part of the brilliance of SDOs is that they do not rely solely on temporary easements to preserve land-use flexibility. As this Essay will discuss in more depth, the call option also serves that end.

III. A NEW FRAMEWORK FOR SOLAR DEVELOPMENT OPTIONS

Despite the promise of SDOs, they have not been implemented or even written about since 2019.[96] Indeed, they may not be ready for implementation given the shortcomings outlined above. An ideal SDO system provides powerful incentives to potential solar developers. Further, it does so without causing overly burdensome restrictions on other kinds of development and without exacerbating urban sprawl. This Part addresses three areas of improvement for SDOs: Section III.A explains the need for a careful economic analysis of easement duration. Section III.B offers a pricing scheme for the SDO call option that gives appropriate consideration to the incentives of solar users. Finally, Section III.C proposes a reevaluation provision that adjusts the call-option price when a solar user upgrades their energy system.

A. *Easement Duration*

Under Landis's approach, the duration of the solar easement would be fixed at a certain number of years, somewhere in the fifteen- to twenty-year range.[97] The main benefit of this approach is that it avoids overprotecting solar rights. If the servient owner can use their land for a more beneficial purpose, they are not foreclosed from doing so; they need only wait until the easement

94. Landis, *supra* note 12, at 1108.

95. John Gekas, *Shining a Light on Maryland's Solar Energy Market & Its Renewable Energy Policies*, 9 ENV'T. & EARTH L.J. 81, 87 (2019) (stating that solar panels may be guaranteed for twenty-five years and can last over thirty years).

96. The author could find only one passing reference to SDOs in an external source. *See* BRUCE ET AL., *supra* note 15, § 12:4.

97. Landis, *supra* note 12, at 1108.

terminates. As a secondary benefit, this approach mitigates the concern that TDR programs contribute to urban sprawl, which would counteract the goal of SDOs.[98]

However, longer easements also have benefits, namely better incentives for solar developers. Thus, increasing duration has costs *and* benefits. Most likely, as duration increases, the marginal cost (in terms of urban sprawl) increases,[99] and the marginal benefit (better incentives for solar users) decreases.[100] A crucial inquiry for easement duration, then, is when the marginal benefit of an additional year of duration equals the marginal cost.

Such an analysis would not be trivial, as there are other considerations regarding the costs and benefits of more protracted easements. For instance, an unfortunate positive feedback loop occurs as a municipality grants more TDRs. As more TDRs enter the market, their value decreases. Consequently, a municipality would have to grant more TDRs to compensate servient estates.[101] Further, since TDRs can be granted without an overt cost to the public, "there is little political accountability associated with their creation."[102]

Certainly, the list of considerations goes on. For now, suffice it to say that the question of easement duration warrants serious attention. However, there is reason to be skeptical of a duration shorter than twenty years. The lifespan of a solar panel is, conservatively, about twenty to twenty-five years.[103] Moreover, a typical solar lease (for land, not airspace) is thirty to fifty years, including renewal term options.[104]

Finally, in evaluating the costs and benefits of extending the duration of the easement, it is important to remember that in an SDO system, a temporary easement is not the only tool to preserve land-use flexibility. The call option allows the servient owner to retake their entitlement, and one would expect them to do so whenever they can put their airspace to more profitable use than

98. *See* Bernard H. Siegan, *Smart Growth and Other Infirmities of Land Use Controls*, 38 SAN DIEGO L. REV. 693, 733 (2001) (noting that "regulations limiting use, density, area and height" contribute greatly to urban sprawl).

99. Intuitively, a real estate developer is less likely to wait for an easement to end in order to develop a building vertically when the easement has ten years left as opposed to one year left. In the former case, the real estate developer is much more likely to take up a project elsewhere, which could exacerbate urban sprawl depending on the location of the alternative project.

100. *Cf.* Caroline Cecot, *Efficiency and Equity in Regulation*, 76 VAND. L. REV. 361, 392 (2023) ("[A]n additional dollar has a greater effect on the welfare of a poor person than a rich person, referred to as the declining marginal utility of income."); Reuven S. Avi-Yonah, *Globalization, Tax Competition, and the Fiscal Crisis of the Welfare State*, 113 HARV. L. REV. 1573, 1649 (2000) (referencing the basic assumption of declining marginal utility of income).

101. *See* Serkin, *supra* note 52, at 915, 925–26 (pointing out a similar devaluing of TDRs that occurs due to the risk that cities will undermine TDRs through new regulation and zoning in response to increased congestion that may result from granting too many TDRs).

102. *Id.* at 926.

103. *See* F. Parks Brown, *Solar Lease Negotiations from the Landowner's Perspective*, 49 TEX. J. BUS. L., FALL 2020, at 1, 8.

104. *Id.* at 3 (describing lease terms for land on which solar panels would be built). Given the timeframe for land leases, thirty years is a natural starting point for SDO easements.

the solar user. To be clear, this is merely a factor in carrying out the cost-benefit analysis described above. How much weight this factor carries must be the subject of future consideration.

B. *Option Pricing*

Call options are the most important feature of SDOs. They are what set SDOs apart from Iowa's system and other proposals advocating for TDRs as compensation to burdened landowners. Further, as discussed, they open the possibility of longer solar easements as they provide another mechanism (apart from temporary easements) to counteract entrenchment of solar rights. This Section proposes a new pricing scheme for SDO call options. Under Landis's framework, the strike price formula can be expressed as follows:

$$P = I - S + U,$$

where P is the strike price, I is the solar user's investment, S is the attributable energy savings, and U is the value of unearned TDRs.

The formula makes some sense. Including I ensures the solar user is compensated for their investment. Subtracting S is a defensible choice; including this term arguably avoids overcompensating the solar user. As previously explained in Section I.B, adding U to the strike price prevents a windfall for the servient owner. However, while the inclusion of this last term makes sense from the standpoint of disincentivizing undesirable behavior from the servient owner, it is quite unclear why the solar user should receive that value. Those TDRs are granted by the municipality. If they go unearned, their value should be returned to the municipality. But this is a simple fix. The U term should be removed from the strike price, but it should still be paid to the municipality. The one caveat is that unearned TDRs that have not been sold should simply be returned, rather than paid for by the servient owner.

The formula poses other problems, though. Most importantly, it fails to provide proper incentives to the prospective solar user. Consider, for example, a hypothetical urban property owner who obtains a solar easement through an SDO program. After eight years, the servient owner sells their property to a real estate developer who wants to build several additional stories that would shade the solar user's panels. Assuming an eight-year payback period for solar panels, the $I - S$ term of the strike-price would be zero.[105] So long as the developer returns any unearned TDRs, they would be able to retake the airspace entitlement at no cost.

Such a risk hardly seems to provide the aspiring solar user with the right incentives. However, the problem runs deeper. Even if the servient owner has no interest in developing their property, they may still be able to extract rent from the solar user merely by threatening to develop their property, all the while still reaping the value of their TDRs.

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105. By definition, the solar payback period is over when the attributable savings equals the investment cost.

Further, when a solar easement can be terminated at no cost, the system becomes less efficient. This is because the servient owner is free to terminate the easement even if they are not the highest-value user of the airspace entitlement. If they stand to gain anything at all from building an addition immediately—as opposed to waiting until the easement expires—they will do so. Of course, the solar user could bargain for continued solar access; however, given the high transaction costs of such bargaining, this is unlikely to occur.[106]

Therefore, a better pricing scheme accounts for the value the solar user places on access to sunlight. Specifically, the strike price should include a term representing the expected future energy savings from the solar panels. This Essay thus proposes the following scheme:

$$P = I - S + F,$$[107]

where P is the strike price, I is the solar user's investment, S is the attributable energy savings, and F is the expected future savings. Including the expected-savings term addresses the risk that the airspace entitlement will revert to the servient owner when they value it less than the solar user. Further, it incentivizes solar development by ensuring that the solar user who successfully obtains a solar easement will reap the full financial benefit of their solar panels whether or not the easement remains in place for the maximum term.

C. *Strike Price Calculation and Easement Renewal*

Even once the pricing scheme for the call option is established, there remains the practical issue of calculating the terms in the strike price formula. At the outset, this Essay proposes that the solar user be responsible for calculating and reporting the strike price in order to reduce administrative costs;[108] however, the servient owner should have access to any data used in the calculation so that they can investigate if they choose.

Turning to the calculation, the simplest term is I (the solar user's investment). This term should include all costs incurred in the installation and maintenance of the solar system. Thus, if the solar user upgrades their energy storage system, repairs a broken panel, or replaces their panels with more efficient ones, the I term should increase to the extent of those costs.[109] Similarly, the I term should increase if the solar user purchases technology that allows them to better monitor their solar system—e.g., software that tracks statistics

106. *Cf.* Bronin, *supra* note 9, at 1229 (noting that an extensive search revealed no cases involving bargaining over express easements). Though there have been some cases dealing with express solar easements since Bronin's 2009 search, such cases remain far and few between.

107. Note that the U term has been removed. However, as discussed, the servient owner would still be required to return the value of any unearned TDRs to the municipality.

108. This raises the question of how often the solar user should calculate and report the strike price (as well as the accompanying data). The obvious starting point would be an annual report. However, a municipality is free to require greater, or lesser, frequency.

109. Separately, this Section suggests that some upgrades should affect the easement term, which will be addressed shortly.

such as peak collection times and individual panel performance.[110] Including such costs in the strike price aids the goal of efficiency because it incentivizes the solar user to behave as though they were guaranteed a maximum easement term.[111]

The next term, *S* (the attributable savings), is slightly more complicated. The value of *S* at the start of the easement term is zero because there are no attributable savings at that point. After that, *S* increases as savings accrue. There are at least five factors involved in energy savings: (1) the electricity cost per kilowatt hour being avoided; (2) the applicability of net metering;[112] (3) the solar user's ability to obtain federal and state tax incentives;[113] (4) the efficiency of the panels; and (5) the level of solar insolation—i.e., the level of solar radiation received in a given area. However, all of these factors (other than the tax benefits) can be accounted for using a monitoring system, such as the one made by Solar City.[114] Thus, municipalities should make obtaining a system with this capability a condition of obtaining an SDO easement.[115] Municipalities will have to decide whether to require solar users to track their tax benefits and reduce the strike price accordingly. To achieve perfect fairness, these benefits would need to be accounted for. On the other hand, tracking and reporting the tax benefits would add undesired complexity.[116]

The final term, *F* (the expected future savings during the easement term), involves the same five factors listed above. However, the term comes with additional complexity because it requires projection. Likely, the best way to do this projection is to use a solar savings calculator, such as the PVWatts calculator from the National Renewable Energy Laboratory.[117] Accuracy will be a concern in any method of projection. However, a solar calculator provides simplicity. While future savings could alternatively be projected based on past savings, this method runs into two problems: First, this method does not work

110. At a certain point, improving one's monitoring may become superfluous, and a municipality is free to limit the kinds of expenses that affect the strike price. However, identifying (and enforcing) those kinds of limitations increases administrative costs.

111. If expenses like monitoring costs were not included in the strike price, the existence of the call option would distort the solar user's behavior. This is because a solar user is less likely to purchase monitoring software when they know there is a chance they will not reap the full value of that software. Forcing the servient estate to compensate the solar user for the software's cost upon termination fixes that problem.

112. "Net metering is an electric billing tool that uses the electric grid to 'store' excess energy produced by your solar panel system." *What Is Net Metering and How Does It Work?*, ENERGYSAGE, https://www.energysage.com/solar/solar-101/net-metering [perma.cc/898W-MN36].

113. *See* I.R.C. § 48 (providing for the Solar Investment Tax Credit).

114. *See* Max Dilthey, *How to Keep Track of Your Solar Savings*, SOLAR POWER AUTH., https://www.solarpowerauthority.com/keep-track-solar-savings [perma.cc/WG5X-M3PG].

115. However, the cost of the system would still be included in the *I* term of the strike price.

116. As a middle ground, a municipality could also apply a standard addition to the *S* term based on average tax benefits. In that case, the solar user should be allowed to track their actual tax benefits and report the true value if they wish.

117. *See* Dilthey, *supra* note 114.

at the start of the easement term, as there are no past savings at that point. Second, the method is incompatible with the goal of incentivizing upgrades. Under such a system, a solar user's upgrade to more efficient panels would not be properly reflected in the strike price; the F term would still be based on the older, less efficient panels. Both problems could be solved by using a solar calculator temporarily when (but only when) necessary. However, this Essay suggests the simpler method of always using a solar calculator when calculating expected future savings.

Finally, the above considerations bring up an additional concern. Although the strike price will increase when a solar user upgrades their solar system, a solar user may still lack full incentives to invest in upgrades, particularly in the later years of the easement term. If there are five years left on a solar easement, the solar user is only guaranteed the full return on investment during those five years. If the solar user installs new panels expected to last thirty years, the final twenty-five years would essentially be uninsured.[118] One partial remedy to this problem could be to allow an automatic renewal term for certain kinds of upgrades.[119] Municipalities would need to determine which upgrades would qualify for a renewal term as well as the duration of the renewal term. Given that solar leases for land typically run for thirty to fifty years,[120] this Essay suggests an initial term of thirty years and a maximum term of fifty years including renewals. However, municipalities could offer longer renewal terms. Additionally, municipalities could also allow for nonautomatic renewals, which would simply involve the same application process as the initial SDO easement. In all respects, this Section merely offers preliminary guidance.

CONCLUSION

Over the coming years, as funding for solar development accelerates—in no small part due to the IRA—solar energy will become increasingly important to climate change abatement efforts. However, the full potential of solar energy will remain unrealized until there is adequate protection for solar-access rights. Without guarantees to unobstructed sunlight, some promising solar projects will not materialize.

The SDO approach proposed by Landis offers a hopeful method of protecting solar rights and incentivizing solar development. However, the approach must be adjusted to be maximally effective in practice. In that vein, this Essay critiques certain aspects of Landis's proposal and offers an updated framework for SDOs. Specifically, this Essay calls for more careful consideration of easement duration, proposes an option-pricing scheme that better accounts for the incentives of solar developers, and suggests provisions for call-

118. This is because the strike price does not compensate the solar user for expected future savings beyond the end of the easement term.

119. Of course, the municipality would then need to grant additional TDRs to compensate the burdened landowner.

120. Brown, *supra* note 103, at 3.

option evaluation and easement renewal. These proposals better align SDOs with the policy of promoting solar development, but retain the benefits of fairness and flexibility in future land use.

SDOs have the potential to transform how urban solar users protect their access to sunlight. Furthermore, their application is not limited to the United States. Indeed, if SDOs are to meaningfully contribute to climate change abatement, their broader adoption may be crucial. However, SDOs have received almost no attention since Landis's note, which proposed the concept. Accordingly, this Essay aims to seize on the current momentum around clean energy to spark discussion of this promising idea, ultimately in the hope that state lawmakers will take notice.