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REASONABLE EMISSIONS OF GREENHOUSE GASES:
EFFICIENT ABATEMENT FOR A STOCK POLLUTANT

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In their contribution to this Symposium, David Hunter and James Salzman note that two critical hurdles for a plaintiff in climate change litigation are the questions of what duty the defendant owes the plaintiff and whether the defendant has breached this duty.[1] I think that Hunter and Salzman are right to focus on the question of what emissions would be reasonable to expect from the defendant, as this element of the plaintiff's case raises some of the most difficult issues for a court to resolve. Unreasonable conduct is an explicit element of a negligence claim.[2] Similarly, to succeed with a nuisance claim, the plaintiff must show "unreasonable interference" with either private use and enjoyment of the plaintiff's land or a right common to the general public.[3] As Hunter and Salzman note, the primary approach to determining whether the defendant's conduct is reasonable is to weigh the costs and benefits of the alternative courses of action, as required by the Learned Hand formula applied to the precautions taken by a defendant in a negligence case.[4] Furthermore, the determination of the reasonable level of emissions is necessary not only to rule on the question of liability but also to determine the appropriate remedy in the event the defendant is held liable. Whether the court awards damages for the harm caused by unreasonable emissions or grants injunctive relief, the court must first determine what emissions are reasonable.

This Commentary will discuss some of the complex problems with which a court would have to grapple in order to determine whether a

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[1] David Hunter & James Salzman, *Negligence in the Air: The Duty of Care in Climate Change Litigation*, 155 U. PA. L. REV. 1741 (2007).
[2] *See id.* at 1748 ("For negligence actions, the general level of the duty of care is well known—to act reasonably or not to act in such a way that creates an unreasonable risk of harm.").
[3] *Id.* at 1788.
[4] *Id.* at 1756-58, 1791.

defendant's emissions of greenhouse gases (GHGs) are unreasonable. For example, Hunter and Salzman state that trends in technology that lower the costs of preventing climate change are making findings of liability more likely over time.[5] This issue is more complicated than it might appear at first blush, however, because the implications of this progress in technology for the liability of any given defendant are ambiguous.

Consider the effect on a defendant of an unexpected innovation that now makes it less costly to abate carbon dioxide emissions. If this innovation lowers the marginal costs of abatement for the defendant in question, then this fact alone makes it more likely for us to deem the defendant's failure to increase abatement to be unreasonable than would be the case in the absence of that innovation. This result follows because the level of abatement that is optimal from the standpoint of economic efficiency would be higher, where the marginal cost of abatement equals the marginal social benefit.[6] With a lower marginal cost at the prior level of abatement, a polluter must now abate more to drive its marginal cost of abatement up until this marginal cost equals the marginal benefit.

Suppose, however, that this innovation reduces the marginal costs of abatement by *others* by much more than it reduces the defendant's own costs. Then it may be reasonable to expect *others* to abate instead.[7] Abatement by others would reduce total expected emissions,

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[5] *Id.* at 1757.

[6] *See* SCOTT J. CALLAN & JANET M. THOMAS, ENVIRONMENTAL ECONOMICS AND MANAGEMENT 86-87 (3d ed. 2004) (illustrating the concept of an "allocatively efficient amount of pollution abatement"). The benefit of each unit of pollution abatement is the damage that would have been caused by the emissions that we avoid by that unit of pollution abatement. Thus, the efficient level of pollution abatement sets the marginal cost of pollution control equal to the marginal damage of the pollution emitted. *See* TOM TIETENBERG, ENVIRONMENTAL AND NATURAL RESOURCE ECONOMICS 340-41 (6th ed. 2003). Economists can illustrate the optimal level of pollution control as the intersection of two sloping curves which represent these two marginal costs as functions of the level of pollution: the marginal costs of abatement increase as we reduce pollution, while the marginal damage of pollution increases as pollution rises. *See id.* at 341. If an innovation causes the curve representing the marginal cost of abatement to shift down, then the point at which these two curves intersect will shift to a lower level of pollution and thus a higher level of abatement.

[7] To minimize the cost of any given level of pollution abatement, the efficient allocation of that abatement among polluters would equalize the marginal cost of pollution control for all polluters. *See* TIETENBERG, *supra* note 6, at 345-46. Economists can illustrate this cost-effective allocation of pollution control between two pollution sources as the intersection of two sloping curves which represent their marginal costs as an increasing function of each source's own level of pollution abatement. *See id.* at

which in turn would *reduce* the harm expected to flow from the defendant's marginal emissions, as long as the marginal environmental cost of GHG emissions is an increasing function of total emissions. The greater the effect of this innovation on reducing abatement costs, the greater the increase in total abatement expected to result, and the greater the reduction in the marginal harm of the defendant's emissions. If the marginal environmental costs of the defendant's emissions fall by more than the decline in its marginal costs of abatement, then we will be *less* likely to deem those emissions socially excessive, not more likely. Thus, the innovation in question would cut in *favor* of the defendant rather than against it.

Furthermore, even if the unexpected innovation reduces the abatement costs equally for all current polluters, the implications of this innovation for a defendant are not necessarily clear. In particular, suppose that this unexpected innovation also causes us to become more optimistic about the likelihood of even lower abatement costs in the future. What makes the duty of care so difficult to determine in the context of climate change is the mechanism of causation. The harm expected to flow from the marginal emission is not simply a function of all the other current emissions of GHGs. Instead, because climate change is a function of the *stock* of GHGs in the atmosphere and not of the current *flow* of these gases into the atmosphere, the harm expected to flow from the marginal emission is a function of all emissions of GHGs that have already occurred, that are currently occurring, and that are expected to occur in the future.[8] That is, to decide what emissions are reasonable now, we cannot simply rely on observations of past and current emissions. Instead, we must make predictions regarding future emissions.

Moreover, because total expected harm is a function of all past, current, and future emissions, it is possible to achieve a given environmental benefit in a number of different ways. We can abate emissions now by a given amount, or we can abate emissions in the future by some amount large enough to achieve the same expected benefit.

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346. If an innovation causes one curve to shift down more for one source than for the other source, then the point at which these two curves intersect will shift toward a higher level of abatement for that source and a lower level of abatement for the other. The source with lower abatement costs must abate more to drive its marginal costs up, while the other source must abate less, until their marginal costs are equal once again.

[8] This fact makes a greenhouse gas a "stock pollutant." *See id.* at 338-39 (discussing stock pollutants); *see also* JONATHAN M. HARRIS, ENVIRONMENTAL AND NATURAL RESOURCE ECONOMICS: A CONTEMPORARY APPROACH 376 (2002).

The possibility of intertemporal substitution makes the question of what abatement is socially optimal now especially tricky. The optimal allocation of abatement would seek to ensure that the marginal cost of abatement sufficient to produce that same marginal environmental benefit is equal not only across space but also across time. If a unit of abatement today and a unit of abatement tomorrow produce the same environmental benefit, for example, then lower abatement costs in the future militate in favor of requiring that unit of abatement later rather than now. This observation would not imply zero abatement now, however, if the marginal benefit of abatement is sufficiently high; the optimal abatement policy would simply require more abatement later than now. Higher levels of abatement in the future would drive up the marginal cost of abatement in the future until it equals the marginal cost of abatement today (after discounting costs to present value).

With these observations in mind, suppose we consider an unexpected innovation that not only reduces a defendant's marginal costs of abatement but also simultaneously causes us to revise our expectations of future technological progress. In particular, suppose the innovation is good news in the sense that we reduce our estimates of abatement costs expected in the future, not only because the innovation in question has become available but also because this innovation is a harbinger of more innovations to come or because it will magnify the benefits that will flow from other innovations that we expect in the future. This revision in our expectations may well reduce the marginal abatement costs that we expect in the future by more than the innovation in question reduces marginal abatement costs for the defendant before us today. If so, it may well be reasonable for us to expect more abatement and lower levels of emissions in the future than we previously expected, which would reduce the marginal benefit of abatement today. If the marginal benefit of abatement today falls by more than the reduction in the marginal cost of abatement today, then the net effect of the innovation in question is to *increase* our estimate of the "reasonable" level of emissions of GHGs today. It may well make sense to defer abatement until the future, when we anticipate that further innovations will reduce abatement costs even more. We would be, on balance, *less* likely to find the defendant liable today as a result of the innovation in question. Thus, a trend toward lower abatement costs as a result of technological progress is a double-edged sword in climate change litigation.

All of these considerations underscore the complexity of the Learned Hand formula and of cost-benefit analysis in the context of climate change, which requires difficult predictions of future costs and benefits. We need to determine not only the path of technological progress in the future but also the future course of public policies in all nations around the globe. After all, whether private firms actually adopt available abatement technologies will depend on whether they have any incentives to do so. Given that abatement is a public good, we would normally expect private parties to use these technologies only if laws and public policies give them the appropriate incentives to do so. Furthermore, we would expect private parties to invest in research and development (R&D) of such technologies only if they expect demand for these technologies in the future, which will depend, in turn, on public policies that give others the incentive to demand these technologies. The incentive to invest in this R&D also may depend directly on public policies that promote such innovation through subsidies, not only indirectly on public policies that promote market demand for these innovations.

Thus, climate change litigation may well pose a "political question," albeit in a somewhat different sense than that suggested by the court in *Connecticut v. American Electric Power Co.*[9] In order to apply the Learned Hand formula accurately, we must make predictions about public policies, which in turn may depend on our beliefs regarding the domestic and international political economy of environmental laws and policies worldwide. A court would have to evaluate the prospects for effective regulation in the future, which would in turn depend on an evaluation of the political power of opposing interest groups. If we are optimistic about the regulation of emissions in the future, then we may be less inclined to demand abatement today. If, on the other hand, we are pessimistic about the prospects for such regulations, then we may be more inclined to demand abatement today. In light of the difficulties and controversies that would arise in any attempt to make such determinations regarding innovations and public policies in the future, a court may be inclined to declare itself incompetent to decide a defendant's liability based on such determinations.

On the other hand, one of the legal developments that may well affect incentives to abate emissions is the very climate change litiga-

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[9] 406 F. Supp. 2d 265, 274 (S.D.N.Y. 2005) (dismissing the suit and holding that it raised "non-justiciable political questions").

tion that is before the court in question. If the court dismisses the plaintiff's claim as nonjusticiable, it thereby diminishes not only the incentives of defendants to abate now, but also the incentives we expect to encourage polluters to abate in the future—assuming that such lawsuits are effective in creating incentives, either directly through trial outcomes or indirectly by causing governments to regulate GHGs. Such a ruling thereby increases our estimate of the environmental costs we expect to bear as a result of the failure to abate now. Ironically, to dismiss the plaintiff's case is also to increase the social costs of dismissing that case, unless one is optimistic regarding the prospects for effective environmental regulations of emissions in the future.

A more limited response to the difficulties in predicting the future would be for a court simply to assume that everyone will do what is reasonable—that is, private parties will abate optimally, and governments will adopt optimal environmental policies. This assumption may be unduly optimistic, and thus lead a court to underestimate the marginal benefits of abatement now, but it would at least avoid controversial predictions regarding the public policies that will actually be adopted in the future. Adopting this assumption would also be better for the plaintiff than dismissing the case outright as nonjusticiable, as it would still leave open the possibility of a successful lawsuit.

Nevertheless, this assumption would leave many difficult factual issues for a court to resolve, questions that may well be beyond a court's ability to answer with accuracy. In light of these problems, courts might consider a whole range of abatement levels to be "reasonable," giving the defendant the benefit of the doubt when there is uncertainty over what level is socially optimal. This option may allow the defendant generous leeway, yet still be better for plaintiffs than outright dismissal of the lawsuit. Plaintiffs may need to suggest such strategies in order to persuade courts to consider their claims at all.