The Price Anderson Act Paradigm as a Model for Regulation of Carbon Capture & Sequestration

I. Introduction

The Price Anderson Act of 1957 ("Act") amended the Atomic Energy Act of 1954 by establishing a liability scheme to provide compensation in the event of a nuclear accident.[1] The Act was originally intended to encourage investment in the fledgling nuclear power industry, when the safety risks were still unknown and thus the potential for liability was great. By limiting liability in the event of an accident, while at the same time providing some level of public compensation for damages, the legislation served as an incentive and the nuclear power industry grew from one reactor in 1957, to 104 today.[2] Liability can be broken down into three tiers of responsibility:

Tier I: Generator Liability

- No fault liability at source in exchange for damages cap
- Licensees required to obtain maximum amount of private insurance available on the market (currently $300 million)
- No individual source liability beyond this amount

Tier II: Collective Generator Liability

- Licensees pay retroactive premiums into pool after incident occurs
- Each licensee obligated up to $95.8 million, paid in annual installments of up to $15 million per year
- Indemnified by federal government beyond this amount

Tier III: U.S. Government Liability

- If damages are likely to exceed aggregate amount of private liability, Nuclear Regulatory Commission reports to Congress and requests appropriations
- Courts make final determination as to whether damages have exceeded aggregate amount
- President estimates damages and recommends compensation plans

Because it regulates liability for a new and potentially risky industry, the Act is one potential model for future regulation of carbon capture and sequestration activities ("CCS"). CCS is a new technology designed to prevent carbon dioxide ("CO2") emissions from reaching the atmosphere and contributing to the global warming effect. The two studies examined below review the particular issues involved with CCS technology and the types of liability schemes that might be most suitable. While drawing

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[1] Price Anderson Nuclear Industries Indemnity Act of 1957, 42 U.S.C. Sec. 2210 et seq. (2008); Atomic Energy Act of 1954, 42 U.S.C. Sec. 2011 et seq. (2008).

[2] Carbon Capture & Sequestration: Framing the Issues for Regulation (CCSReg Project, Carnegie Mellon University, 2008), p. 108-110.

on some elements of the Act as a solution, both studies conclude that regulation of CCS will require a more adaptive model with additional mechanisms to ensure adequate compensation in the event of an accident.

II. Price Anderson Act

The Price Anderson Act has been amended multiple times, most recently by the Energy Policy Act of 2005, which extended it through 2025.[3] The basic liability scheme remains in place, however, and essentially provides a no fault system in exchange for a cap on liability damages. This is accomplished through the creation of a three-tiered model of responsibility, where industry provides the first $10 billion in compensation and the federal government takes responsibility for damages over that amount.[4] Damages include personal injury, property damages, including loss of value or loss of use, and financial loss due to protective actions such as evacuation.[5]

The first level of responsibility remains at the source of the accident. The regulations require a licensee of a reactor over 10 megawatts to carry the maximum amount of private liability insurance available on the market ($300,000,000 at the present time), or to provide evidence of comparable resources, or some combination of the two.[6] Should damages from an accident exceed this amount, a second tier of protection is triggered: a form of collective liability funded from a pool consisting of deferred premiums paid by all licensees. Each licensee is obligated to provide up to $95.8 million in funds, paid in annual installments of up to $15 million per year, until either the damages claim is satisfied or the $95.8 million individual cap is reached. Payment is retroactive and the pool is not created until after an incident occurs. The premium amounts are adjusted for inflation at five year intervals.[7] For both types of coverage, there is also some flexibility in terms of total liability and amount of coverage required for licensees of more than one reactor, and sites with multiple reactors.[8]

Licensee liability is capped at the total amount of private liability insurance plus the available amount in the pool. This amount will vary according to the number of reactors in operation, and currently totals over $10 billion.[9] Industry is indemnified by the federal government for damages beyond that amount, and thus the third tier of responsibility lies with the federal government. Funding would come from Congressional appropriations, based on a report by the Nuclear Regulatory Commission ("NRC"), a determination by the courts whether damages exceeded the aggregate amount, and an estimate of additional damages by the President, including recommendations for additional sources of funds and compensation plans.[10]

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[3] Energy Policy Act of 2005, 42 U.S.C. Sec. 15801 et seq. (2008).
[4] Carbon Capture & Sequestration, p. 110.
[5] 10 C.F.R. Sec. 140.84-140.85 (2008).
[6] 42 U.S.C. Sec. 2210(b)(1); 10 C.F.R. Sec. 140.14.
[7] 42 U.S.C. Sec. 2210(b)(1); 42 U.S.C. Sec. 2210(t).
[8] 42 U.S.C. Sec. 2210(b)(2)(A); 10 C.F.R. Sec. 140.11.
[9] Carbon Capture & Sequestration, p. 110.
[10] 42 U.S.C. Sec.2210(i).

In order for claimants to obtain compensation quickly, the Act eliminates certain issues and defenses normally available to defendants in a tort action. Should the NRC determine an event to constitute an "extraordinary nuclear occurrence," a licensee would be held to a strict liability standard and claimants would not have to prove fault. Extraordinary nuclear occurrences are those in which a discharge has caused substantial radiation offsite, and where there has been substantial damage to person(s) and/or property. Damage to person(s) is determined based on federal dose limits. The Act provides that licensees waive the defenses of negligence, contributory negligence, assumption of the risk, unforeseeable intervening causes, charitable or governmental immunity, and statute of limitations. A defendant may still defend any issues regarding the nature of the damages, causal relationship, the amount of damages, and a claimant's failure to mitigate damages. The waivers do not apply to situations where the claimant intentionally caused the accident. [11]

The 1988 amendments to the Act provided for an exclusive federal cause of action, eliminating state court jurisdiction and state law actions for punitive damages, and preempting any state law inconsistent with the Act. Jurisdiction lies with the federal district court in the district in which the accident occurs.[12]

III. Carbon Capture and Sequestration

Carbon capture and sequestration is a technology designed to capture carbon dioxide emissions from industrial sources, convert them into a liquid, and inject them deep into geological formations underground. The goal is to prevent such emissions from reaching the atmosphere and contributing to the global warming effect of greenhouse gases, by sequestering them safely and permanently underground.[13] Coal used in electricity-generating plants is the largest contributor to greenhouse gases, yet is also an inexpensive and widely available source of fuel. CCS is a method of reducing emissions while still enabling the use of inexpensive fossil fuels such as coal.[14]

Commercial development of CCS projects will be influenced by increasing greenhouse gas emissions regulations. When total CO2 emissions are capped at a certain level, a price will be established for CO2. The amount of CO2 captured and injected permanently into the ground would be excluded from emissions calculations, and thus there would be a financial incentive for industries to participate in the CCS process.[15]

CCS projects will have a specific life cycle, starting with site selection and injection of CO2, continuing with closure of the well and post-closure monitoring and finally ending with long-term stewardship of the site. Initially the CO2 would be restrained physically by the geological formation into which it is injected. During this period the greatest risks

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[11] 42 U.S.C. Sec. 2210(n)

[12] Price Anderson Amendments Act of 1988, Pub.L.No. 100-408, 102 Stat. 1066, August 20, 1988; Alexandra B. Klass & Elizabeth J. Wilson, Climate Change & Carbon Sequestration: Assessing a Liability Regime for Long-Term Storage of Carbon Dioxide, 58 Emory L.J. (draft p.49) (2008).

[13] Climate Change, p.2.

[14] Climate Change, p.6.

[15] Id., p.15.

are leakage or migration, due to the buoyant properties of the CO2, and increased geologic pressure due to volume.[16] Over time, CO2 would be come less buoyant and pressure would return to an equilibrium state. Although the greatest risk of a problem occurring would probably be during the first few decades after closure of a site, the entire process could take hundreds of years, and therefore long-term monitoring would be necessary.[17]

Although a large release of CO2 would be unlikely, a highly concentrated leak could occur, resulting in potential human injury and ecological harm. Re-release of CO2 into the atmosphere could affect emissions cap and trade programs, and thus cause financial losses as well. Migration underground is also possible and could contaminate groundwater or hydrocarbon resources. Finally, increased geological pressure could lead to seismic activity.[18] If a site has been chosen and managed properly, these risks could be lowered and therefore of particular concern for regulators will be how to ensure care in choosing, operating, and maintaining a site. Still, much about how CO2 in large volumes will behave underground over time is unknown, and there is inherent risk in undertaking such projects.[19]

CCS is a new technology and because of the extensive volume of CO2 involved in such operations and the extremely long time frame required, there are inherent uncertainties involved. It will be necessary to regulate the process and allocate liability in such a manner as to reduce the risk of investment, provide incentive for maintaining a proper standard of care, and assure that there is public compensation for any losses. The following two studies suggest potential regulatory frameworks for liability related to CCS projects. Both explore a variety of approaches, including the viability of a Price Anderson model. Although the solutions proposed do not fit exactly into a Price Anderson paradigm, there are several shared characteristics. Ultimately, both studies conclude that the unique issues involved in CCS technology require an adaptive and graduated approach, taking into consideration the maturity of the CCS industry, and the stage of the CCS project.

IV. University of Minnesota Law School Study

The authors of this study propose an adaptive model of liability at the federal level to help address the inherent difficulties that could arise in CCS projects. Such a model would rely on various forms of compensation, including bonds, insurance, and pooling, in order to protect investors from excess liability. The authors also suggest drawing on existing environmental and tort liability schemes to augment a federal model, so as to ensure adequate public protection in the event of an accident. They suggest that a Price Anderson model might be useful during the early years of a CCS industry to encourage

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[16] Id., p.3, 9-12; Carbon Capture & Sequestration, p.46.
[17] Carbon Capture & Sequestration, p. 47, 50-51.
[18] Climate Change, p.5, 12.
[19] Carbon Capture & Sequestration, p.1, 45.

investment, but reject the idea of a permanent cap on corporate liability, citing the need to maintain an incentive to choose and monitor sites carefully.[20]

Given the inherent uncertainties involved in a new industry such as CCS, the authors suggest that the first dozen or so CCS projects be regulated under a shared public and private liability scheme to help the industry get established. They propose a strict liability scheme with a cap on damages, which would be funded by the federal government. They also argue that tort and environmental claims for damages beyond this amount should be allowed as extra protection for the public.[21] They next examine the characteristics of various existing federal and state environmental and tort liability schemes that could be incorporated into a model for regulation after the pilot stage is over.

The Resource Conservation & Recovery Act ("RCRA") is a federal environmental statute addressing the handling, storage, and disposal of solid and hazardous wastes, while the Comprehensive Environmental Response, Compensation & Liability Act ("CERCLA") provides for cost recovery from past contamination.[22] Because CO2 is not likely to be classified as a hazardous waste, neither RCRA nor CERCLA would be the best regulatory tool standing alone. Additionally, neither statute provides for personal injury or property damages.[23] However, the authors suggest that some elements of CERCLA in particular might be useful in formulating a regulatory framework. CERCLA is retroactive, applying to contamination that occurred at a time when the conduct may have been legal, and it also provides for strict and joint and several liability, meaning that all past and current owners are liable regardless of knowledge of or participation in the contamination. These elements would address liability for damages resulting from unforeseen problems that may occur before proper regulation is in place, as well as the difficulty of finding responsible parties far into the future.[24]

The authors also examine potential common law claims for damages relating to CCS projects, including trespass, negligence, nuisance, and strict liability. While they maintain that common law remedies should remain available until a framework specific to CSS is established, they recognize that there may be difficulties in establishing standards of care, showing causation, and providing consistency across jurisdictions.[25] For example, different injection sites will inevitably have varying geological characteristics, leading to potential differences in the behavior of CO2 underground. This could impact performance from site to site.[26] There could be questions about causation if multiple injectors are using the same site, and conflicts between state laws, where the geology straddles state lines.[27] Additionally, some of the common law doctrines take into

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[20] Climate Change, p.3, 51.
[21] Id., p.4, 53.
[22] Resource Conservation & Recovery Act of 1976, 42 U.S.C. Sec. 6901 et seq. (2008); Comprehensive Environmental Response, Compensation & Liability Act of 1980, 42 U.S.C. Sec. 9601 et seq. (2008).
[23] Climate Change, p.17, 19-21.
[24] Climate Change, p. 22.
[25] Id., p. 23-31, 35.
[26] Id., p. 31, 56.
[27] Id., p. 26.

consideration a cost/benefit analysis based on public policy, and the reduction of greenhouse gas emissions could potentially be seen as outweighing private interests.[28] It is also likely that, as with the Price Anderson Act, any federal legislation covering CSS activities would provide for federal preemption of state laws. This would provide more predictability and consistency for the CSS industry, but the authors are concerned that it would limit public access to adequate compensation.[29]

Another model of liability discussed in the study is the Trans-Alaska Pipeline Liability Fund, which created a federal fund for quick payment of claims, while preserving a claimant's ability to pursue additional damages under state tort law.[30] The fund is financed by fees paid by owners on each barrel traveling the pipeline. Owners are held to a strict liability standard, with the responsible party paying out first up to a certain amount, and the fund paying the rest. A savings clause allows parties to seek punitive damages under state law. The authors find these provisions and the general structure of superimposing a federal compensation scheme on top of existing liability law to be potentially applicable to regulating CCS technology.[31]

As mentioned above, the authors suggest that the Price Anderson Act could serve as a model for the early years of CCS activity. They disapprove of a permanent cap on corporate liability, however, and point out that the risks involved with CCS and nuclear power are very different. There is less possibility of a catastrophic accident occurring with CCS injection, and the risks are better-known and more manageable.[32] However, in their ultimate recommendations for a model of liability, the authors do draw on some elements of the Act.

Ultimately, the authors propose a three-tiered system of compensation tied to the stages of a CCS project. During the injection stage, the project operator would be liable for any damages, and would be required to hold insurance to cover such damages. Full liability would encourage proper site assessment and good practices. Also during this period the operator would make payments into a central fund pool, preferably held at the federal level so as to spread the risk most widely. This pool could be from either fees based on performance, or per ton of CO2 injection, thus correlating income with contribution. The pool would serve as prepayment for long-term stewardship costs. Once the injection site is closed, a project would enter the post-closure stage. During this period the operator would be responsible for monitoring and remediation costs, and would remain fully liable for any damages. The authors suggest that existing environmental and tort laws be used to supplement any federal regulation in place by this time. Operators could turn to bonding or insurance to cover the cost of damages, and potentially to an industry-funded insurance pool with caps on individual liability.[33]

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[28] Id., p. 26, 31.
[29] Id., p. 41-42.
[30] Trans-Alaska Pipeline Authorization Act of 1973, 42 U.S.C. Sec. 1661 (2008).
[31] Climate Change, p. 51-53.
[32] Id., p. 50.
[33] Climate Change, p. 55-56.

Because the behavior of CO2 underground will vary according to the geology of each site, and because this will not be fully known until injection actually occurs, the authors suggest that site performance be evaluated on a periodic basis and incorporated into site models. Based on this data, payments into the prepayment pool and bond or insurance premiums could be adjusted to accurately reflect site performance. This would create an ongoing incentive for responsible site choice and management. [34]

The final stage of a CCS project would be long-term stewardship of the site to monitor for releases and provide any necessary remediation. Although the risk would go down with time, the extremely long time frame involved would necessitate both a long-term caretaker and assurances of continuing availability of compensation over many years. The federal government would probably be in the best position to meet these needs, given that the lifespan of corporations is generally much shorter, and administration on a state or geologic level might not spread the risk evenly. Monitoring and remediation would be funded exclusively from the federal pool funded from operator prepayments.[35]

V. Carnegie Mellon Study

The authors of this study also address the question of how to regulate liability in CCS projects. In reviewing potential regulatory frameworks for the injection process and beyond, they reach many of the same conclusions as the previous study, with some variation in the models proposed.

The authors go further than the previous study by examining issues related to regulation of the initial capture and transportation of CO2. They determine that questions of liability for these stages could be addressed with existing regulatory schemes, particularly those applied to large industrial facilities operations and natural gas pipelines.[36] The authors also examine the question of ownership of the subsurface injection space (pore space); however this discussion relates more to compensation for loss of property rights, rather than potential liability for damages.[37] Ultimately the authors determine that it is the CCS process at the site that requires a unique solution, particularly the post-closure and long-term stewardship stages.[38]

As in the previous study, the authors argue that site selection will critically affect the potential for future leakage or migration, even more so than how well the site is operated.[39] This will require regulatory accountability so as to ensure care in choosing a site. Through its authority under the Safe Drinking Water Act, the EPA has proposed to create a new class of wells to be part of its Underground Injection Control Program ("UIC").[40] Class IV wells would be solely for CO2 injection for sequestration purposes. Regulations would cover construction requirements, and require monitoring, remediation,

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[34] Id., p. 56-57.
[35] Id., p. 4, 54-56.
[36] Carbon Capture & Sequestration, p. 101.
[37] Carbon Capture & Sequestration, p. 56-57.
[38] Id., p. 101.
[39] Id., p.45.
[40] Safe Drinking Water Act of 1974, 42 U.S.C. 300f; Carbon Capture & Sequestration, p. 77-78.

and post-closure plans in order to receive a permit. Applicants would also have to show ability to provide financial resources for remediation and care of the site up to 50 years after closure, or until the CO2 was stable. Regulations would be flexible and adaptive to site performance.[41]

Although inclusion in the UIC program could provide one possible form of regulating CCS activities, the authors state that it is insufficient for several reasons. First, the Safe Drinking Water Act is designed to protect groundwater, and so the EPA's authority is limited in terms of addressing other critical issues, such as human and ecological health, long-term liability, greenhouse gas accounting, and even the risk of surface leakage.[42] Additionally, because of the strong state participation in UIC oversight, there is the potential for jurisdictional conflicts and thus less predictability for investors.[43]

Still, the authors believe that modification to the UIC program could provide a framework for permitting early projects, until a new federal statute covering all CSS concerns could be implemented. Advantages of relying on a UIC model include drawing on the program's experience, pre-existing relationships with state regulatory agencies, and ability to more quickly roll out a framework that involves making adaptations to existing regulations, rather than waiting for entirely new legislation.[44] This two-stage approach is similar to that proposed in the first study, in its reliance on existing law to provide some framework for regulation. The authors of the Carnegie Mellon study also suggest that states be given some role in the oversight and implementation of a UIC model, and that there be a provision for citizen suits in any liability scheme, so as to provide an additional mechanism for enforcement.[45]

In crafting a more permanent regulatory scheme, the authors believe that, as with the capture and transport stages, liability during the operational stage of a CCS project could be addressed by existing regulation of large industrial projects. For example, the siting process could be held to a strict liability standard if permit requirements were not met, thus providing the ultimate incentive to choose carefully. A negligence standard could be used at the injection stage, retaining traditional defenses for the defendant.[46] Liability in the post-closure and long-term stewardship stage would fall into one of three categories: tort, trespass, or contract. Trespass might include damage to mineral rights, while contract damages could mean loss of emissions credits. The authors focus on tort damages in reviewing the potential various statutory and common law remedies available.[47]

Although RCRA and CERCLA provide good incentives to take greater care, as in the first study, the authors do not believe CCS constitutes a hazardous activity and so these

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[41] Carbon Capture & Sequestration, p. 77-79.
[42] Id., p. 79.
[43] Id., p. 79-81.
[44] Id., p. 85.
[45] Id., p. 88-89.
[46] Carbon Capture & Sequestration, p. 104-105, 115.
[47] Id., p. 103.

statutes would not be appropriate.[48] They also believe that a strict liability standard in general would discourage investment. Recognizing that uncertainty is part of the risk an investor takes to gain from the rewards available in the marketplace, the authors acknowledge that such risk should be as clear and quantifiable as possible.[49]

Another potential model of liability could be based on worker's compensation statutes. These provide limited liability based on performance, drawing on pooled funds to cover compensation.[50] While pool-based funds tend to lower individual incentive to perform, contributions based on past performance could offset this. Additionally, a fixed amount of recovery (e.g. with no punitive damages) would create certainty and eliminate the need to show fault. The authors believe such a model could work for the operational phase of a CCS project.[51]

The authors also consider the Price Anderson Act model of liability, noting the similar need to encourage development of a new and risky industry, and the potential usefulness of a cap on liability in the early stages, perhaps using lower thresholds.[52] They recognize that there may need to be a cost/benefit analysis, weighing the possibility of uncompensated public losses in the event of a CCS accident, versus the uncompensated public losses that will result from continuing emissions.[53] However, as with the first study, the authors believe that permanent elimination of liability would adversely affect incentive to operate safely.[54] They also note that the Price Anderson Act does not address the issue of funding the cost of long-term stewardship of a site, a problem inherent to CCS activities.[55]

Financial liability during the siting, injection, and operational process could be covered by private insurance. If insurance is too difficult to obtain, then the authors suggest a damages cap or a performance-based pooled fund.[56] The authors also recommend that operators remain liable for damages occurring during the post-injection and closure stage, since the greatest chance of leakage is during this period.[57] Financial responsibility for damages occurring during the long-term stewardship phase could be allocated in one of several ways. First, responsibility could remain with the operator on a permanent basis. However, as discussed before, the lifespan of corporations will generally be much shorter than the time it takes for a site to fully stabilize, thus leaving the public with no resource for compensation. Alternatively, the states could be responsible for sites within their borders, and some states are already doing this by establishing trust funds. However, there is the possibility that such a burden will fall too heavily on some states, such as

[48] Id., p. 106.
[49] Id., p. 101.
[50] Id., p. 107.
[51] Id., p. 107-108.
[52] Id., p. 110.
[53] Id.
[54] Id., p. 104.
[55] Id.
[56] Carbon Capture & Sequestration, p. 113.
[57] Id.

those with multiple sites, and there could be complications if CO_2 migrates across jurisdictions.[58]

Another option would be to allocate responsibility to a private entity, on a geographical or state basis, or for the entire country. The federal government could provide regulatory guidance and oversight, requiring the entity to carry insurance coverage, but with a cap on liability. The government would cover damages beyond that, from a self-financing source such as a pool.[59]

As in the first study, however, the authors believe that the federal government itself is best suited to handle long-term stewardship. With greater resources and the ability to better spread the risk, it would also lend to the creation of more uniform regulations, and better oversight of the emissions market.[60] To finance such an undertaking, the authors propose the creation of a sinking fund, financed by fees paid by operators during the operational phases of the project, based on ton of CO_2 injected. The fee could be flexible, based on geologic risk, and a structure could be developed based on data collected from the first 10 or so projects.[61] Unlike the first study, the authors suggest retaining some sort of operator liability even during the long-term stewardship phase. They propose that any claims arising during this period for damages that occurred prior to the transfer of responsibility, should remain the responsibility of the project entity.[62] The authors do not, however, explain how such claims could be funded in the event the project entity no longer existed.

VI. Parallels and Differences

Both studies examined concur that the Price Anderson Act contains some useful elements for a model of regulatory liability for CCS activities. The novelty of both industries, the potential for safety risks from technologies not yet fully understood, and the need to provide an incentive for development are the main shared characteristics. Accordingly, both studies suggest that initial caps on industry liability might be necessary to encourage development, but only for early projects. A long-term or permanent cap on liability would serve as a disincentive to take care with site selection and operations, both of which are critical to decreasing the potential for an accident.

There are also inherent and substantial differences between the nuclear power and CCS technologies would that necessitate a different model of regulation for the CCS industry. Apart from the (separate) issue of nuclear waste disposal, nuclear energy activities and concomitant dangers cease when power plants shut down. Potential damages from CCS activities do not end with closure of an injection well. Rather, due to the need to sequester CO_2 on a permanent basis, and the length of time it takes CO_2 to become stable, accidents are an on-going possibility over decades and maybe longer. Even if

[58] Id., p. 94-95.
[59] Id., p. 96-97.
[60] Id., p. 95-96.
[61] Id., p. 96-97.
[62] Id., p. 113-114

such accidents are not potentially as catastrophic as a nuclear accident, the time period will require legislators to frame liability issues in a different way. The need to provide monitoring and ensure compensation over an extended period of time calls for a reliable and solvent caretaker. Both studies agree that the federal government is in the best position to take on this responsibility.

Another difference between nuclear energy and CCS activities is that a CCS project can be divided into distinct stages, with the potential for an accident varying according to stage, and ultimately decreasing over time. This gives legislators the opportunity to create a flexible and adaptable regulatory scheme, tying responsibility to performance by adjusting fees and liability caps. In a departure from the Price Anderson model, both studies suggest that industry should retain full responsibility for compensation during the active stages of a CCS project, through private insurance or bonding. The first study argues that claims under existing environmental and tort laws should be allowed for damages beyond those covered by insurance, at least in the early years of the industry. Similarly, the second study proposes a liability scheme for the early stages of a project that draws on tort doctrines such as strict liability and negligence.

Long-term stewardship should also be financed by industry, but through a pool financed by operator fees and administered by a central body (preferably the federal government, but not necessarily). As with the Price Anderson model of paying annual premiums, this would spread the risk more evenly across the industry. However, unlike Price Anderson, such premiums would not be retroactive, but would be tied to either the size of the operations or performance. This would reduce the possibility that the federal government would have to pursue indemnification claims in the event of default.[63]

One final difference between the nuclear energy and CCS industries is the new issue of climate change. While nuclear energy could be seen as a beneficial and profitable technology, the practice of CCS has an additional dimension. It would serve to reduce greenhouse gas emissions and hopefully slow the effects of climate change. Therefore a cost/benefit analysis might find that even though some of the financial burden might ultimately fall on the public (i.e. by having to subsidize industry for damages), this is seen by the authors of the second study as a perhaps inevitable socialization of risks.[64]

VII. Conclusion

The outcome of the Price Anderson Act has been the growth of the nuclear power industry, and with it a gradual shifting of the bulk of liability away from the federal government to industry. This is due to the various amendments increasing the amount of liability insurance required, and it is also a function of the increasing number of operating reactors, which increases the overall pool of funds available, thus decreasing potential federal liability. To date, no incident has occurred which has required the use of funds beyond the first tier of protection. Still, the federal government could potentially bear an enormous amount of liability, given the catastrophic nature of nuclear damages. As a

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[63] 10 C.F.R. Sec.140.20 (2008).
[64] Carbon Capture & Sequestration, p. 116.

regulatory model for the nascent CCS industry, the Price Anderson Act offers some potentially useful tools for allocating liability. However, both studies examined conclude that ultimately a legislative solution tailored to the unique aspects and challenges of CCS activities will be required in order to find a balance between private responsibility and public protection.

Note: The Appendix below summarizes the recommendations of the Minnesota and Carnegie studies in terms of the three tiers in Price Anderson.

Appendix:

The three tiers of liability in the Price Anderson model can serve as an analytical metric to measure regulation of liability for damages from CCS activities. Following is a schematic representation of this metric as applied to the Minnesota and Carnegie Mellon studies:

	Price Anderson Act	**University of Minnesota Study**	**Carnegie Mellon Study**
Tier I: Generator Liability	• Liability remains with the source but is capped • Licensees required to obtain maximum amount of private liability insurance available on market (or show proof of comparable resources). Currently $300 million • Strict liability for "extraordinary nuclear occurrences" • Exclusive federal cause of action; elimination of state court	• Liability remains with the source during injection, closure, and post-closure period • Individual operators would hold private insurance or bonds from injection through post-closure stages; caps and premiums are risk-based and site specific (based on performance) • Individual operators still subject to existing tort and environmental laws for damages beyond insurance caps • Federal preemption is likely, but federal and state bases for individual liability	• Liability remains with the source at all stages to some degree • Individual operators would hold private insurance or bonds from injection through post-closure stages • Capture and transport stages can be regulated by existing liability schemes for major industrial processes and gas pipelines • Permitting process for early projects could be regulated under modified UIC program with state oversight until CCS-specific

	jurisdiction • Preemption of state law inconsistent with Act; no state law action for punitive damages	should be preserved	legislation in place; individual applicants must show proof of financial resources for site care and remediation • Alternative for early projects is Price Anderson model - individual insurance with liability cap using lower thresholds • Once industry is established, traditional tort law principles would apply: strict liability standard for failure to comply with siting permit requirements, negligence standard for operations phase • Operators remain responsible during long-term stewardship stage for damages occurring prior to transfer of responsibility
Tier II: Collective Generator Liability	• Each licensee pays premium into pool • Payment is retroactive and	• First dozen projects: Operators pay into federal fund with strict liability damages cap,	• Performance-based pooled fund based on Worker's Compensation statutes if

	pool is not created until after incident occurs • Each licensee obligated up to $95.8 million, paid in annual installments of up to $15 million per year, until damages claim is satisfied or individual cap reached • Premium amounts adjusted for inflation every five years • Licensees indemnified by federal government for damages beyond this amount	federal government pays for damages over cap; claimants can use tort & environmental law for damages not covered by fund • After industry established, operators pay per-ton or performance-based injection fee into pool – correlation of income or performance with contribution • Pool should be held at federal level to spread risk over all sites – avoids issue of multiple injectors at one site and geologic basins straddling state lines • Alternative to individual insurance (see Tier One) is pooled insurance, across different projects with individual liability caps – but still need to ensure individual due diligence	insurance too costly or not available for individuals (see Tier One); fixed and limited recovery amount in exchange for liability without fault • Operators pay fees into sinking fund, based on ton of CO_2 injected, and geological risk based on data from early projects
Tier III: U.S. Government Liability	• Nuclear Regulatory Commission reports to Congress to request	• Time or performance-based transition to third party ownership for long-term	• States should not handle long-term stewardship – burden would not be equal and CO_2 migration

	appropriations • Courts determine whether damages exceed aggregate • President estimates damages, recommends source for additional funds and compensation plans • Risk is gradually transferred away from government as industry grows and pool amount increases	stewardship phase (because lifespan of firms will be shorter than monitoring period) • Monitoring and remediation during this phase financed by industry-funded pool created by fees paid during active operation • Administration of industry-funded pool should be national to spread risk	could cause jurisdictional problems • Private entity could handle under federal regulatory guidance – financed by insurance with cap on liability; federal government responsible for damages beyond this amount, but paid from self-financing source such as a pool • Federal government in best position to handle – greater resources and better risk-spreading; long-term monitoring and remediation costs financed by sinking fund