

The Overallocation Problem In Cap-And-Trade: Moving Toward Stringency

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INTRODUCTION

Many view cap-and-trade regulation as the most promising policy tool for reducing the emission of traditional air pollutants as well as greenhouse gases that cause climate change.¹ The political success of cap-and-trade can be credited to its ability to accommodate the very distinct interests at play in environmental policy. Regulated sources like the trade part of cap-and-trade. They tend to support cap-and-trade regulation because of the compliance flexibility that trading provides. Individual regulated sources have much greater flexibility than they did under conventional regulation to decide if, how, and when they will reduce emissions.² Environmentalists, on the other hand, like cap-and-trade because of the cap. They view the cap as providing certainty about the overall amount of pollution that will be emitted by the set of sources included in the program over the program's lifetime.³

The environmental gains of cap-and-trade programs depend on the level of the program cap. The program cap in a cap-and-trade program is the overall regulatory goal, and its level is the "key

1. Byron Swift, *How Environmental Laws Work: An Analysis of the Utility Sector's Response to Regulation of Nitrogen Oxides and Sulfur Dioxide Under the Clean Air Act*, 14 TUL. ENVTL. L.J. 309, 315 (2001); see also EPA, Clean Air Rules of 2004 (July 11, 2008), <http://www.epa.gov/cleanair2004> (stating that the Clean Air Interstate Rule and the Clean Air Mercury Rule employ a cap-and-trade approach) (last visited March 26, 2009); MARKET ADVISORY COMMITTEE TO THE CALIFORNIA AIR RESOURCES BOARD, RECOMMENDATIONS FOR DESIGNING A GREENHOUSE GAS CAP-AND-TRADE SYSTEM FOR CALIFORNIA 6 (June 1, 2007), available at http://www.climatechange.ca.gov/events/2007-06-12_mac_meeting/2007-06-01_MAC_DRAFT_REPORT.PDF [hereinafter MAC REPORT].

2. By "conventional regulation," I refer to what others have labeled "command and control regulation." The latter term should be avoided because it fails to capture many aspects of environmental regulation as it has been implemented over the past several decades. See Daniel H. Cole & Peter Z. Grossman, *When is Command-and-Control Efficient? Institutions, Technology, and the Comparative Efficiency of Alternative Regulatory Regimes for Environmental Protection*, 1999 WIS. L. REV. 887, 892 (1999) (stating that use of the term "command and control" is oversimplified); David M. Driesen, *Is Emissions Trading an Economic Incentive Program?: Replacing the Command and Control/Economic Incentive Dichotomy*, 55 WASH. & LEE L. REV. 289, 296-99 (1998) (arguing command and control programs are not as rigid as often described in criticism); A. Denny Ellerman, *Are Cap-and-Trade Programs More Environmentally Effective than Conventional Regulation*, in MOVING TO MARKETS IN ENVIRONMENTAL REGULATION: LESSONS FROM THIRTY YEARS OF EXPERIENCE 48, 49 (Jody Freeman & Charles Kolstad eds., 2007) (stating that the term command and control is a "semantic triumph" of economists and "not a very precise term for identifying the essential difference between the contending instruments . . .").

3. See, e.g., Eileen Claussen & Judith Greenwald, *Op-Ed: Cap & Trade vs. Tax, Handling Climate Change*, MIAMI HERALD, July 12, 2007, available at http://www.pewclimate.org/press_room/opinion_editorials/oped_miamih07122007.

factor in the environmental success of a cap-and-trade program.”⁴ If the cap is not adequately stringent, the program will not achieve its environmental goals even if sources comply with the cap. In several existing cap-and-trade programs, the caps have not been adequately stringent. These programs suffered from the problem of overallocation, with caps that allowed sources to make few, if any, emissions reductions from business-as-usual emissions. While advocates of these programs may boast about participants’ overcompliance with the program cap, such overcompliance has often been the product of an overallocation of allowances.

This article examines the overallocation problem present in four major cap-and-trade programs, including the United States Acid Rain Program (ARP), Los Angeles Regional Clean Air Markets (RECLAIM), the Chicago Emissions Reduction Market System (ERMS), and Phase I of the European Union Emissions Trading System (EU ETS). ERMS and Phase I of the EU ETS were characterized by “absolute overallocation,” meaning that allowance allocations were greater than emissions and expected to remain greater than emissions such that the price of allowances collapsed. RECLAIM and the ARP had “early overallocation,” with allowance allocations greater than emissions in the program’s early years. As discussed below, overallocation and its accompanying effects compromised the environmental effectiveness of these cap-and-trade programs.

The first part of this article describes existing cap-and-trade programs, with a focus on how caps have been set and how emissions under the programs have compared to their caps. The second part of the article shows the two ways in which overallocation occurs in existing programs: either throughout the program or in the early years of implementation. It also discusses the effects of overallocation, which include low allowance prices, delays in emissions reductions, and the buildup of large allowance banks. The third part of the article discusses how cap-and-trade programs can move toward stringency. It argues that caps in cap-and-trade programs should require emissions reductions at least as great as those that could be achieved by mandating the use of

4. Dallas Burtraw et al., *Economics of Pollution Trading for SO₂ and NO_x*, 30 ANN. REV. ENV'T & RESOURCES 253, 259 (2005) (further stating that “as with any regulatory program, the level of environmental protection may hinge on political factors as much as it hinges on science.”).

technologically and economically feasible emissions control technologies. In addition, this article advocates the use of a ratchet to reduce initial caps to levels warranted by feasibility. To ensure that the cap retains stringency throughout the life of the program, the article argues in favor of incorporating mechanisms capable of adjusting program caps based on new information about feasibility and program outcomes.

I. CAP-AND-TRADE PROGRAMS: CAPS AND EMISSIONS

Cap-and-trade programs designed to regulate air pollution emissions share the same basic structure. The government establishes a cap on the total emissions of a certain pollutant from a set of regulated sources over a fixed compliance period. The cap is then divided into allowances, each representing the right to emit a unit of the pollutant. The government allocates allowances among the regulated sources, and the sources may then trade them. At the end of the compliance period, each regulated source must show that it holds a sufficient number of allowances to cover the units of pollution that it emitted. Most often, annual caps have been defined at the outset for the lifetime of the program, and regulated sources know how many they will receive each year. If a program allows banking, then sources may save unused allowances for use or trade in a future year of the program.

Remarkably, there is little written on the topic of how caps in cap-and-trade programs should be set. One might think that little has been written because the process is straightforward. Rather, many difficult theoretical and practical issues arise in setting the level of the cap. This section describes key characteristics of four major cap-and-trade programs with an emphasis on how the caps were set and the emissions that resulted in each program.⁵

5. Three other programs also deserve mention: the Regional Greenhouse Gas Initiative (RGGI), the United States NO_x Budget Trading (NBP) Program, and the Houston/Galveston Mass Emission Cap & Trade (MECT) Program. RGGI caps CO₂ emissions from the electric power sector in ten Northeastern and Mid-Atlantic states for the years 2009 through 2018. See <http://www.rggi.org/home>. The cap for 2009 through 2014 is set at 188 million short tons, which is approximately 4% above annual average emissions for the participating sources in the period 2000 to 2004. In the years 2015 to 2018, the cap declines by 2.5% each year to reach a 2018 cap that is 10% below the 2009. See RGGI, OVERVIEW OF RGGI CO₂ BUDGET TRADING PROGRAM 2 (Oct. 2007), http://www.rggi.org/docs/program_summary_10_07.pdf (last visited March 26, 2009). On expected overallocation in RGGI, see *infra* note 258 and accompanying text. See also Felicity

A. The U.S. Acid Rain Program

Commentators have hailed the United States Acid Rain Program (ARP) as a very successful cap-and-trade program.⁶ They contend that it has significantly reduced the sulfur dioxide (SO₂) emissions from power plants responsible for acid deposition and adverse health effects.⁷ The ARP was implemented in two phases. Phase I set caps for the years 1995 to 1999, and Phase II for the years 2000 to 2010.

Phase I imposed a cap on SO₂ emissions from the 263 largest, highest-emitting coal-fired electricity-generating units in the country.⁸ An initial allocation of allowances to each unit was set forth in “Table A” of the statute.⁹ The basic formula used to generate these allocations involved multiplying the source’s average fuel consumption in the baseline years of 1985 through 1987 (“baseline utilization”) by an emissions rate of 2.5 pounds of SO₂ per million BTU.¹⁰ The regulated sources were also permitted

Barringer & Kate Galbraith, *The Energy Challenge: States Aim to Cut Gases by Making Polluters Pay*, N.Y. TIMES, Sept. 16, 2008, at A17. The NBP was designed to reduce NOx emissions from large stationary sources in the eastern United States, primarily power plants. In 2003, the first year of the program, 18% more allowances were allocated than sources needed to cover their emissions. EPA, NOX BUDGET TRADING PROGRAM: 2003 PROGRESS AND COMPLIANCE REPORT 15, fig. 11 (Aug. 2004), <http://www.epa.gov/airmarkets/progress/docs/noxreport03.pdf>. The MECT program established an annual cap on NOx emissions for certain existing stationary facilities in the Houston-Galveston non-attainment area. See TEXAS COMMISSION ON ENVIRONMENTAL QUALITY, MECT PROGRAM AUDIT 1 (May 2006), <http://www.tceq.state.tx.us/assets/public/implementation/air/banking/reports/2006mectreport.pdf>. Almost 50% of the allowances allocated in 2002, the first year of the program, expired unused. *Id.* at 13. Despite evidence of overallocation, these programs are not included in the present analysis because either the program is very recent (in the case for RGGI) or not enough information was available to draw conclusions about the extent of overallocation.

6. See, e.g., David Harrison Jr. et al., *Using Emissions Trading to Combat Climate Change: Programs and Key Issues*, 38 ELR NEWS & ANALYSIS 10367, 10370 (2008); Robert N. Stavins, *A Meaningful U.S. Cap-and-Trade System to Address Climate Change*, 32 HARV. ENVTL. L. REV. 293, 300 (2008); Dallas Burtraw & Byron Swift, *A New Standard of Performance: An Analysis of the Clean Air Act’s Acid Rain Program*, 26 ELR 10411 (1996).

7. Lauraine G. Chestnut & David M. Mills, *A Fresh Look at the Benefits and Costs of the US Acid Rain Program*, 77 J. OF ENVTL. MGMT 252, 255–56 (2005).

8. EPA defines a “unit” as a fossil fuel-fired combustor that serves a generator that provides electricity for sale. EPA, ACID RAIN PROGRAM 2004 PROGRESS REPORT 5 (2005), available at <http://www.epa.gov/airmarkets/progress/docs/2004report.pdf> [hereinafter ACID RAIN PROGRAM REPORT 2004]. The 263 units included in Phase I of the program were located in 110 generating plants. A. DENNY ELLERMAN ET AL., MARKETS FOR CLEAN AIR: THE U.S. ACID RAIN PROGRAM 6 (2000) [hereinafter MARKETS FOR CLEAN AIR].

9. Clean Air Act, 42 U.S.C. § 7651c(e)(3) tbl.A (2000).

10. MARKETS FOR CLEAN AIR, *supra* note 7, at 7, 39–41; but see *id.* at 39–41 (discussing how

to receive additional allowances for various reasons such as installing scrubbers,¹¹ making voluntary emissions reductions before 1995,¹² and undertaking efficiency and renewable energy measures.¹³ Moreover, utilities made extensive use of the program's "Substitutions" provision.¹⁴ This allowed them to substitute units of their choice for the units specified in the statute and receive allocations of allowances based on the historic emissions of those units.¹⁵ The initial allocations contained in Table A summed to about 5.5 million tons of SO₂. Incorporating all the additional sources of allocations, the cap in 1995 totaled about 8.7 million tons (see Table 1).¹⁶

In Phase II, which began in 2000, the program expanded to include a total of 2262 electricity-generating units.¹⁷ The basic formula used to generate allocations involved multiplying the unit's baseline utilization by an emissions rate of 1.2 pounds of SO₂ per million BTU.¹⁸ This emissions rate had historical significance, as it was the rate that had been required for new coal fired plants since

the analysis of how the statutory allocations differed from this basic formula); *see also* Swift, *supra* note 1, at 319 n.34.

11. 42 U.S.C. § 7651c(d)(1). Scrubbers are an end-of-the-pipe pollution control device that removes pollutants from industrial exhaust streams.

12. *Id.* § 7651c(e)(1).

13. *Id.* § 7651c(f)(2); EPA, 1995 COMPLIANCE RESULTS: ACID RAIN PROGRAM 2 Exhibit A (July 1996), [hereinafter ACID RAIN PROGRAM REPORT 1995]. *See also* MARKETS FOR CLEAN AIR, *supra* note 7, at 39–41 (describing the various provisions under which additional allowances were allocated and analyzing how these provisions were the result of rent-seeking behavior).

14. 42 U.S.C. § 7651c(b).

15. MARKETS FOR CLEAN AIR, *supra* note 7, at 199. *See also* Sam Napolitano et al., *The U.S. Acid Rain Program: Key Insights from the Design, Operation, and Assessment of a Cap-and-Trade Program*, 20 ELECTRICITY J. 47, 49 (2007) (noting that additional units, numbering between 135 and 182, joined as "substitution, compensating and opt-in units" in various years of Phase I).

16. Over the remainder of Phase I, the cap declined as some of the sources of additional allowances were phased out. In 1999, the total cap was about 7 million tons (*see infra* Table 1).

17. EPA, ACID RAIN PROGRAM: ANNUAL PROGRESS REPORT (August 2001) [hereinafter ACID RAIN PROGRAM REPORT 2000]. In subsequent years of Phase II, the number of electricity-generating units regulated under the program tended to increase, reaching 3520 in 2006. EPA, ACID RAIN AND RELATED PROGRAMS, 2006 PROGRESS REPORT 8, available at <http://www.epa.gov/AIRMARKETS/progress/docs/2006-ARP-Report.pdf> [hereinafter ACID RAIN PROGRAM REPORT 2006].

18. *See* Swift, *supra* note 1, at 319 n.34. *But see* MARKETS FOR CLEAN AIR, *supra* note 10, at 44 (explaining that "the statute contains over thirty individual allocation rules that provide for deviations from this simple formula" and analyzing how the allocation rules were influenced by rent-seeking behavior).

1970 under the New Source Performance Standard program.¹⁹ After allocations were calculated using this formula, the statute required the EPA to apply a ratchet such that this initial allowance allocation did not exceed 8.9 million tons.²⁰ As a result, allocations were reduced pro rata by about 10%.²¹ The cap was then augmented, however, through various other allocation provisions to amount to almost 10 million allowances in 2000.²² In 2001, the cap was about 9.6 million tons and, thereafter, the cap has stood at about 9.5 million tons.²³ In 2010, many of the allocation provisions that augmented the Phase II caps lose effect, and the cap will decline to 8.9 million tons.²⁴

In Phase I, sources emitted significantly less SO₂ each year than allowed. In 1995, the first year of the program, emissions were 39% below the cap, and in the following four years, annual program emissions were consistently at least 23% below the annual cap. The ARP allowed unlimited “banking,” meaning that sources could hold onto any allowances that they were allocated or otherwise acquired for use or transfer in any future year of the program.²⁵ As described below, sources established large banks of allowances over the course of Phase I.

19. Swift, *supra* note 1, at 319 n.34.

20. Clean Air Act, 42 U.S.C. § 7651b(a)(1) (2000). See *infra* note 196 and accompanying text for further discussion of this provision. See also EPA, TECHNICAL DOCUMENTATION FOR THE 1998 REALLOCATION OF ALLOWANCES 12 (Sept. 1998), available at <http://www.epa.gov/AIRMARKETS/trading/docs/techdoc.pdf> [hereinafter TECHNICAL DOCUMENTATION].

21. TECHNICAL DOCUMENTATION, *supra* note 18, at 3.

22. ACID RAIN PROGRAM REPORT 2000, *supra* note 17, at 7 exhibit 5 (showing the addition of early reduction credits, allowances for substitution units, allowance auctions, opt-in allowances, and small diesel allowances to arrive to a total 2000 allocation of 9,966,531 allowances).

23. See ACID RAIN PROGRAM REPORT 2006, *supra* note 17, at 8 fig.2. The primary difference in the caps between the year 2000 and the remainder of phase II is that 416,989 “early reduction credits” were allocated in year 2000 under Section 404(e). See ACID RAIN PROGRAM REPORT 2000, *supra* note 17, at 7 exhibit 5; EPA, ACID RAIN PROGRAM, 2001 PROGRESS REPORT 7 fig.5 (Nov. 2002) [hereinafter ACID RAIN PROGRAM REPORT 2001].

24. Larry B. Parker, Robert D. Poling & John L. Moore, *Clean Air Act Allowance Trading*, 21 ENVTL. L. 2021, 2025 n.12 (1991). See also TECHNICAL DOCUMENTATION, *supra* note 20, at 6, fig.1.2 (showing that the cap in 2010 and beyond will actually be 8.7 million tons after adjustments).

25. OFFICE OF AIR AND RADIATION, U.S. ENV'T PROTECTION AGENCY, EPA430-B-03-002, TOOLS OF THE TRADE: A GUIDE TO DESIGNING AND OPERATING A CAP AND TRADE PROGRAM FOR POLLUTION CONTROL 3-19 and Glossary-2 (2003) [hereinafter TOOLS OF THE TRADE]

Table 1. United States Acid Rain Program (ARP), 1995-2006²⁶

Year	Cap (tons of SO ₂)	Total allowable emissions (with bank) (tons of SO ₂)	Emissions from Phase I sources (tons of SO ₂)	Emissions from Phase I and II sources (tons of SO ₂)	Size of bank (tons of SO ₂)
1995	8,744,081	8,744,081	5,298,429	11,870,000	3,441,572
1996	8,296,548	11,732,337	5,433,351	12,510,000	6,279,309
1997	7,147,464	13,435,799	5,474,440	12,980,000	7,955,368
1998	6,969,165	14,928,841	5,298,498	13,100,000	9,627,980
1999	6,990,132	16,618,112	4,944,676	12,460,000	11,607,955
2000	9,966,531	21,583,540		11,201,911	10,381,541
2001	9,553,657	19,933,611		10,633,035	9,300,576
2002	9,542,478	18,842,616		10,193,684	8,653,843
2003	9,541,085	18,817,903		10,595,944	7,591,959
2004	9,541,085	17,116,044		10,259,771	6,856,273
2005	9,539,575	16,385,052		10,222,847	6,162,205
2006	9,539,575	15,655,637		9,392,922	6,262,715

In most years of Phase II, according to Table 1 below, sources collectively emitted at levels above the annual caps. As banked allowances were made available by sources that had previously banked them, however, Phase II sources were easily able to acquire the extra allowances needed to cover their emissions and remain in compliance. As such, during Phase II, sources began a slow draw-down of the large bank of allowances built up in Phase I.²⁷ Program emissions in 2006, however, were below the number of allowances distributed that year, thus increasing rather than

26. Data compiled from U.S. ENV'T PROTECTION AGENCY, PROGRESS REPORTS, 1999-2006, ACID RAIN PROGRAM, <http://www.epa.gov/airmarkets/progress/progress-reports.html>.

27. Burtraw et al., *supra* note 4, at 260 (stating, "In Phase II, emissions have exceeded the annual allowance allocation by 1 to 1.5 million tons each year by drawing on the allowance bank, which is expected to be exhausted over the decade.").

reducing the number of banked allowances.

B. The Los Angeles Regional Clean Air Incentives Market

The Los Angeles Regional Clean Air Incentives Market (RECLAIM) is the longest-running cap-and-trade program in the United States. The RECLAIM program, designed and administered by the South Coast Air Quality Management District (SCAQMD), began operating in 1994. The goal of the program was to reduce nitrogen oxide and nitrogen dioxide (collectively known as NO_x) emissions in the air district that interfered with the attainment of the National Ambient Air Quality Standards (NAAQS) for ozone.²⁸ In 2001, because of the program failure described below, the SCAQMD significantly restructured the program.

SCAQMD calculated allowance allocations in 1994, the first year of RECLAIM, by selecting each source's highest year of production in a four-year baseline period from 1989 to 1992 and determining the level of emissions allowed under existing regulatory requirements.²⁹ Then, based on the emissions reductions expected to be achieved if the control measures defined by SCAQMD's 1991 Air Quality Management Plan (AQMP) had been applied, SCAQMD determined allowance allocations for the year 2000 and applied them to individual sources.³⁰ SCAQMD calculated the final

28. The program also created a cap-and-trade program for SO₂ emissions, but this article will not be concerned with this aspect of RECLAIM. The air district is composed of all of Orange County and the urban portions of Los Angeles, Riverside and San Bernardino counties.

29. More specifically, throughput (a measure of production) was multiplied by an emission factor that represents the level of pollution control required by regulations in effect as of December 31, 1993, the day before RECLAIM went into effect. Matthew Polesetsky, *Will a Market in Air Pollution Clean the Nation's Dirtiest Air?: A Study of the South Coast Air Quality Management District's Regional Clean Air Incentives Market*, 22 *ECOLOGY L.Q.* 359, 385 (1995). See also James M. Lents, *The RECLAIM Program (Los Angeles' Market-Based Emissions Reduction Program) at Three Years*, in *EMISSIONS TRADING: ENVIRONMENTAL POLICY'S NEW APPROACH* 223 (Richard F. Kosobud et al. eds., 2000). Sources were also granted bonus allowances (in the form of Emission Reduction Credits) when they could show that they had made emissions reduction beyond those required by law in the years leading up to RECLAIM. For a more detailed description of how allocations were set, see SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT, REGULATION XX—REGIONAL CLEAN AIR INCENTIVES MARKET, RULE 2002, available at <http://www.aqmd.gov/rules/reg/reg20/r2002.pdf>; See also Meredith Lynn Fowle, *Firm Behavior in Pollution Permit Markets* 129–30 (2006) (unpublished Ph.D. dissertation, U.C. Berkeley) (on file with Giannini Foundation Library, U.C. Berkeley).

30. Lents, *supra* note 29, at 224. The baseline used for the 2000 allowance allocations was actually a six-year baseline (1987–1992) rather than a four-year baseline. *Id.* See also

allowance allocations for 2003 by reducing the 2000 allocations by the percentage necessary to achieve the 2003 emissions targets set in the 1991 AQMP for sources included in RECLAIM.³¹ With allowance allocations set for 1994, 2000, and 2003, allocations for the interim years (1995 to 1999 and 2001 to 2002) were calculated by making a linear fit between the starting and ending points for each source.³² RECLAIM did not allow banking because it was designed to ensure that the sources achieved the emissions targets set for the years 2000 and 2003.³³

Although the allocation methods in RECLAIM and ARP were similar, there was one critical difference. Both were based on historical annual production multiplied by an emissions rate, but RECLAIM's allocation process used the highest production year over a multi-year baseline period while ARP's allocation process used an average of the production years in the multi-year baseline period. SCAQMD justified the use of the highest production year in setting the allowance allocations for the initial year by pointing to the recessionary economic status in the RECLAIM baseline period.³⁴ The result, however, was that the total allowance allocation was greater than in any of those prior years.³⁵

SCAQMD projected that allocations would be in excess of actual

Polesetsky, *supra* note 29, at 386.

31. The sum of the 2000 allocations exceeded this amount by 26% for NOx. Lents, *supra* note 29, at 224.

32. *Id.* at 225.

33. SCAQMD, OVER A DOZEN YEARS OF RECLAIM IMPLEMENTATION: KEY LESSONS LEARNED IN CALIFORNIA'S FIRST AIR POLLUTION CAP-AND-TRADE PROGRAM I-2-1 (June 2007) [hereinafter OVER A DOZEN YEARS OF RECLAIM]. While banking was not allowed, a small amount of intertemporal trading was enabled through a program design that included two different compliance cycles offset by six months. Sources assigned to different compliance cycles could trade with each other, allowing them to, in effect, bank allowances for six months. *See id.*; *see also* David Harrison, Jr., *Ex Post Evaluation of the RECLAIM Emissions Trading Programmes for the Los Angeles Air Basin*, in ORGANIZATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD), TRADEABLE PERMITS: POLICY EVALUATION, DESIGN AND REFORM 48 (2004).

34. *See* Reimund Schwarze & Peter Zapfel, *Sulfur Allowance Trading and the Regional Clean Air Incentives Market: A Comparative Design Analysis of Two Major Cap-and-Trade Permit Programs?*, 17 ENVTL. & RES. ECON. 279, 287 (2000).

35. Lents, *supra* note 29, at 223–224; Schwarze & Zapfel, *supra* note 34, at 287; *see also* SCAQMD, PROPOSED AMENDMENTS TO REGULATION XX—REGIONAL CLEAN AIR INCENTIVES MARKET (RECLAIM) 2 (Jan. 7, 2005), http://www.aqmd.gov/reclaim/reclaim_annurpt.htm (stating that “the program was initially over allocated, which led to an under-utilization of available, cost-effective technologies”) [hereinafter RECLAIM PROPOSED AMENDMENTS 2005].

emissions for “the first few years.”³⁶ In actuality, allocations remained significantly in excess of emissions for five years, through 1998 (see Table 2). In 1994, the first year of the program, emissions were 37% below the cap, and in the following four years, annual program emissions continued to be more than 15% below the annual cap. Finally, in 1999, program emissions were just under the number of allowances distributed that year. In 2000, demand for allowances and allowance prices skyrocketed in the midst of California’s electricity crisis, and emissions exceeded allowances by 19%.³⁷

In the face of this significant noncompliance, SCAQMD partially dismantled the RECLAIM program in 2001 and began using conventional technology-based regulation to regulate large emitters.³⁸ SCAQMD prohibited power-producing facilities—which represented a third of all program emissions in the year 2000—from buying or selling RECLAIM allowances, and required them to install Best Available Retrofit Control Technology by the end of 2003.³⁹ Meanwhile, SCAQMD required other RECLAIM facilities to submit compliance plans or forecast reports indicating their compliance strategies.⁴⁰ After the amendments, RECLAIM emissions fell significantly. By 2004, power producing facilities reduced their emissions by 90% from their 2000 levels.⁴¹ Other facilities reduced their emissions by 31% over the same period.⁴² In the years 2002 through 2006, annual emissions have been at least 20% lower than the program cap.⁴³

36. OVER A DOZEN YEARS OF RECLAIM, *supra* note 33, at III-1-3.

37. Paul L. Joskow, *California’s Electricity Crisis*, 17 OXFORD REV. OF ECON. POL’Y 365, 379–80 (2001). In 1999, as the so-called “cross-over point” when demand for allowances was expected to meet supply came into sight, the market price for NOx allowances rose to \$1827 per ton. SCAQMD ANNUAL RECLAIM AUDIT REPORT FOR THE 1999 COMPLIANCE YEAR F-18 (2001). In 2000, with the concurrence of the electricity crisis and the arrival of the cross-over point, the year of the electricity crisis, allowance prices spiked to an average of \$45,609. *Id.*

38. Joskow, *supra* note 33, at 384; *see also* Lesley K. McAllister, *Beyond Playing “Banker”: The Role of the Regulatory Agency in Emissions Trading*, 59 ADMIN. L. REV. 269, 290 (2007).

39. Compliance Plan for Power Producing Facilities, AQMD Rule 2009 (May 11, 2001) (as amended Jan. 7, 2005).

40. McAllister, *supra* note 38, at 290.

41. *Id.* at 291.

42. *Id.*

43. SCAQMD, ANNUAL RECLAIM AUDIT REPORT FOR THE 2006 COMPLIANCE YEAR 3-3 (2008) [hereinafter RECLAIM AUDIT 2006].

Table 2. Los Angeles Regional Clean Air Incentives Market (RECLAIM), 1994-2006⁴⁴

Year	Cap (tons of NO _x)	Emissions (tons of NO _x)
1994	40,127	25,314
1995	36,031	25,764
1996	32,017	24,796
1997	27,919	21,786
1998	24,678	20,982
1999	21,013	20,775
2000	17,197	20,491
2001	15,693	15,721
2002	14,044	10,943
2003	12,484	9,942
2004	12,477	9,953
2005	12,484	9,556
2006	12,487	9,166

In 2005, SCAQMD allowed power producing facilities to participate in the RECLAIM market again.⁴⁵ Amendments to the program made at the same time also provided that the overall NO_x cap would be reduced by 20% between 2006 and 2011.⁴⁶ With these changes, the cap will reach 9676 tons in 2011, which is approximately the same level at which all the RECLAIM facilities emitted in 2005.⁴⁷

C. The Chicago Emissions Reduction Market System

The Chicago Emissions Reduction Market System (ERMS) cap-and-trade program was implemented by the Illinois EPA in the year 2000 to control emissions of volatile organic materials (VOMs) in Chicago, Illinois. VOM reductions were deemed necessary under the Clean Air Act Amendments of 1990 to meet NAAQS for ozone

44. Data compiled from SCAQMD, RECLAIM ANNUAL REPORTS, 1994-2006, http://www.aqmd.gov/reclaim/reclaim_annurpt.htm.

45. SCAQMD, ANNUAL RECLAIM AUDIT REPORT FOR THE 2005 COMPLIANCE YEAR 3-1 (2007) [hereinafter RECLAIM AUDIT 2005].

46. *Id.* at 2.3 (showing that 50% of the 20% reduction would occur in program year 2007, and then 12.5% in each of the years 2008-2011).

47. *Compare id.* at Fig. 2-1 (showing 2011 cap of 9676 tons), *with id.* at T.3-1 and T.3.3 (showing 2005 cap of 12,484 tons and 2005 emissions of 9556 tons).

in the “ozone season” of May through September when episodes of high concentrations of urban ozone commonly occur.⁴⁸ The ERMS included 190 stationary sources that had historical emissions of more than ten tons of VOMs during the ozone season.⁴⁹

The Illinois EPA based allocation of allowances on source emissions during the period from 1994 to 1996. The agency calculated an emissions baseline for each source by averaging its two highest seasonal emissions levels during this period.⁵⁰ The source’s cap for the duration of the program was then set 12% lower than its emissions baseline.⁵¹ The total program cap each year was the sum of all the sources’ caps, and that cap did not decline over the duration of the program.⁵² Each allowance authorized the emission of 200 pounds of VOMs.⁵³

In 2000, the first year of the program, emissions were 39% below the cap: there were 95,398 allowances, but emitters only needed 59,112 to cover emissions (see Table 3).⁵⁴ In later years of the program, the number of allowances allocated continued to far outstrip emissions, and in 2003 and 2004, emissions were more

48. David A. Evans & Joseph A. Kruger, *Where are the Sky’s Limits? Lessons from Chicago’s Cap-and-Trade Program*, ENV’T, Mar. 2007, at 20–21; RICHARD F. KOSOBUD, HOUSTON H. STOKES, CAROL D. TALLARICO & BRIAN L. SCOTT, COST-EFFECTIVE CONTROL OF URBAN SMOG: THE SIGNIFICANCE OF THE CHICAGO CAP-AND-TRADE APPROACH 15, 33 (2006).

49. Evans & Kruger, *supra* note 48, at 22 tbl.1a. Sources with more than 15 tons of VOMs during the ozone season were required to participate in the market, while sources with emissions between 10 and 15 tons could opt in voluntarily. Kosobud et al., *supra* note 48, at 33.

50. Sources could petition to have an alternate year between 1990 and 1997 be used as a baseline if the period of 1994 to 1996 was somehow unrepresentative. Sources that over-complied with emissions requirements during the period of 1994 to 1996 could also petition for an adjustment. Evans & Kruger, *supra* note 48, at 23; Kosobud et al., *supra* note 48, at 33.

51. Evans & Kruger, *supra* note 48, at 22 (stating that ERMS included a 12% reduction from baseline to achieve the required 3% annual reduction in VOMs from 1997 to 1999 and an additional 3% reduction contingency required by the Clean Air Act Amendments of 1990). Emissions that were already subject to the fairly strict direct regulation were exempted from the 12% reduction on the basis that there was little room for reductions. This essentially gave sources credit for emissions reductions made before the beginning of the program. Kosobud et al., *supra* note 48, at 33 (commenting that approximately half of emitters in ERMS had some portion of their emissions exempted from further reductions, and that these exempted emissions made up about 18% of baseline emissions.).

52. The total program cap actually tended to increase as the number of sources included in the program grew from 190 in 2000 to 236 in 2005. See Evans & Kruger, *supra* note 48, at 28–29 tbl.2.

53. *Id.*, at 22.

54. ILLINOIS EPA, ANNUAL PERFORMANCE REVIEW REPORT—2001, EMISSIONS REDUCTION MARKET SYSTEM, May 15, 2002, 13, available at <http://www.epa.state.il.us/air/erms/apr/2001/apr-2001-text.pdf>.

than 50% below the cap. The ERMS program provided that allowances could be banked for one season; they could be used either in the season they were issued or in the following season.⁵⁵ Because there were so many more allowances than needed to cover emissions, a very large number of allowances were banked each year. In 2003, sources banked almost twice the number of 2003 allowances as they used to cover their emissions.⁵⁶

Table 3. Chicago Emissions Reduction Market System (ERMS), 2000-2007⁵⁷

Year	Cap (No. of allowances)⁵⁸	Emissions (No. of allowances)
2000	95,398	59,152
2001	97,124	51,703
2002	98,164	51,164
2003	97,859	43,601
2004	98,011	44,537
2005	100,635	42,354
2006	100,363	42,470
2007	100,363	41,143

D. The European Union Emissions Trading Scheme

The European Union Emissions Trading Scheme (EU ETS) is the largest cap-and-trade program yet implemented and the first to address emissions relating to climate change. The EU ETS includes approximately half of the European Union's carbon dioxide (CO₂) emissions,⁵⁹ generated by about 11,500 stationary

55. Evans & Kruger, *supra* note 48, at 23.

56. In 2003, sources were allocated 97,859 allowances, of which they banked 84,678. Sources used about 30,000 previously-banked "2002 vintage" allowances as well as about 13,000 "2003 vintage" allowances to cover the approximately 43,000 allowances worth of emissions that they emitted in 2003. See Kosobud et al., *supra* note 48, at 31 tbl.3.1.

57. Data compiled from ILLINOIS EPA, ANNUAL REVIEW PERFORMANCE REPORTS, 2000-2006, EMISSIONS REDUCTION MARKET SYSTEM, <http://www.epa.state.il.us/air/erms/apr/>.

58. Each allowance represents permission to emit 200 pounds of VOMs (volatile organic materials). Kosobud et al., *supra* note 46, at 32.

59. A. Denny Ellerman & Barbara K. Buchner, *The European Union Emissions Trading Scheme: Origins, Allocation, and Early Results*, 1 REV. OF ENVTL. ECON. & POL'Y 66, 68 (2007); A. Denny Ellerman and Paul L. Joskow, THE EUROPEAN UNION'S EMISSIONS TRADING SYSTEM IN PERSPECTIVE 2-3 (2008), available at <http://www.pewclimate.org/eu-ets> (also noting that in

sources in 25 countries. The EU implemented the EU ETS in two phases. Phase 1 was a pilot phase that covered the years 2005 through 2007. Phase 2, named the Kyoto Phase, covers the years 2008 through 2012 to correspond with the first Kyoto Protocol commitment period.⁶⁰ For each phase, the EU set a multi-year cap with no limit on banking within that phase.⁶¹ The EU ETS did not permit banking between Phase 1 and Phase 2.⁶²

Phase 1 caps were determined through a process in which each European member state established a National Allocation Plan (NAP) that required approval by the European Commission (EC).⁶³ Member states thus made the initial decisions regarding the total number of allowances allocated and how these allowances should be distributed to sources in their jurisdiction.⁶⁴ Most member states allocated allowances to sources according to their historical emissions during recent years and distributed allowances free of charge.⁶⁵ Before approval, the EC adjusted allowance allocation downward in 14 of the 25 proposed NAPs.⁶⁶ The overall program cap for Phase 1 was then the sum of the allowances allocated in the NAPs.

Despite the adjustments, emissions data for the year 2005 showed that the Phase 1 cap was likely to exceed Phase 1 emissions.⁶⁷ Indeed, for the entire trading period extending from 2005 through 2007, the EU ETS had allocated about 5.6% more allowances than needed to cover emissions (see Table 4).⁶⁸ Emissions by covered

2007, Romania and Bulgaria became EU member states, raising the number of participating countries to 27).

60. Ellerman & Buchner, *supra* note 59, at 67.

61. Ellerman & Joskow, *supra* note 59, at 3.

62. *Id.*; Harrison et al., *supra* note 6, at 10377.

63. Ellerman & Buchner, *supra* note 59, at 71.

64. Marcus Ahman, Dallas Burtraw, Joseph A. Kruger, & Lars Zetterberg, *The Ten-Year Rule, Allocation of Emission Allowances in the EU Emission Trading System 2*, Discussion Paper June 2005, available at <http://www.rff.org/documents/RFF-DP-05-30.pdf> [hereinafter THE TEN-YEAR RULE]. Annex III of the EU directive concerns allocation set out some basic allocation rules. *Id.*

65. Ellerman & Buchner, *supra* note 59, at 73, 76–78 (stating that Denmark, Hungary, Lithuania, and Ireland chose to auction 5%, 2.5%, 1.5%, and 0.75% of their respective totals).

66. *Id.* at 71.

67. *Id.* at 78.

68. See *infra* Table 4; see also Press Release, European Community, Emissions trading: 2007 verified emissions from EU ETS businesses, (May 23, 2008), <http://europa.eu/rapid/pressReleasesAction.do?reference=IP/08/787>.<http://europa.eu/rapid/pressReleasesAction.do?reference=IP/08/787> (last visited March 26, 2009).

sources increased during Phase I by about 2%, contrary to the goal of reducing emissions for compliance with the Kyoto Protocol.

After the experience of Phase 1, the EC made efforts to set a more stringent cap for Phase 2. The Phase 2 cap, covering the years 2008 through 2012, was set about 13% lower on an annual average basis than the Phase 1 cap and 6% lower than comparable 2005 emissions.⁶⁹ The EC also proposed a third trading period, covering the years 2013 through 2020, in which the cap would be 11% lower on an annual average basis than the Phase 2 cap.⁷⁰

Table 4. European Union Emissions Trading Scheme (ETS), Phase 1, 2005-2007⁷¹

Trading Period	Cap (tons of CO ₂)	Emissions (tons of CO ₂)
2005-2007	6,455,778,519	6,095,607,894

II. THE OVERALLOCATION PROBLEM

The empirical evidence from existing cap-and-trade programs suggests that caps have not been very stringent. Rather, there has been a tendency in program design and implementation toward overallocating allowances.⁷² A cap-and-trade program is overallocated if annual caps are set at levels beyond “business-as-usual” (BAU) emissions.⁷³ While precisely quantifying BAU emissions requires a complicated econometric exercise, taking into

69. Ellerman & Joskow, *supra* note 59, at 32.

70. *Id.* at 34, 49 n.4.

71. Press Release, European Union Emissions Trading System, Emissions Trading: 2007 Verified Emissions From EU ETS Businesses, IP/08/787 (May 23, 2008), available at <http://europa.eu/rapid/pressReleasesAction.do?reference=IP/08/787>.

72. See Tom Tietenberg & Nick Johnstone, *Ex Post Evaluation of Tradable Permits: Methodological Issues and Literature Review*, in TRADEABLE PERMITS: POLICY EVALUATION, DESIGN AND REFORM 9, 32 (Organization for Economic Co-operation and Development ed., 2004) (stating that “Defining a sufficiently stringent cap to ensure that scarcity arises has not always been the case” and citing RECLAIM as an example); T.H. Tietenberg, EMISSIONS TRADING: PRINCIPLES AND PRACTICE 142 (2006) (finding “some tendency to over-allocate quote in the initial program years to gain political feasibility for the system.”).

73. A. Denny Ellerman & Barbara Buchner, *Over-Allocation or Abatement? A Preliminary Analysis of the EU Emissions Trading Scheme Based on the 2005-06 Emissions Data*, 41 ENVTL. & RESOURCE ECON. 267, 271 (2008) (“Probably all would agree that handing out more allowances than BAU emissions would constitute over-allocation.”).

account economic and other factors that would affect emissions in the absence of regulation,⁷⁴ the emissions of program participants in years prior to program commencement reasonably serves as an indicator of BAU emissions. If the program cap allows participants to emit more than they emitted in years preceding the program, the cap is likely overallocated. This section describes the phenomena of absolute and early overallocation in cap-and-trade programs and then explains the effects of such overallocation on program outcomes.

A. Absolute Overallocation

With absolute overallocation, program emissions are lower than the cap and are expected to be lower than the cap in the future. In other words, there is a fundamental lack of scarcity of allowances. Absolutely overallocated programs are likely to be ineffective in reducing emissions. ERMS and Phase 1 of the EU ETS both suffered from absolute overallocation.

In ERMS, the participants' emissions were already 33% below the first year's cap two years before the program began in 2000.⁷⁵ In the program's first year, allowance allocations exceeded emissions by 39%. The number of allowances issued each year continued to exceed the amount needed to cover emissions, and in 2005, there were almost three times as many allowances issued as there were emissions. While participants made use of their ability to bank allowances for a year, many banked allowances ultimately expired unused.⁷⁶

In Phase 1 of the EU ETS, program caps were also above BAU emissions. Analyzing 2005 and 2006 emissions data, one study found that the cap allowed for 125 million tons of CO₂ emissions above BAU, about 3% of covered emissions for these years.⁷⁷ The study also found that the program spurred a similar amount of abatement in these years and thus concluded that the surplus of allowances that characterized Phase 1 was due to a combination of overallocation and abatement.⁷⁸ Another study of the same data

74. See *MARKETS FOR CLEAN AIR*, *supra* note 8, at 110–11; Evans & Kruger, *supra* note 48, at 28–29.

75. Evans & Kruger, *supra* note 48, at 25 (In 1998, emissions were 67% of 2000 cap).

76. Kosobud et al., *supra* note 48, at 6, 31 tbl.3.1 (“Expired ATUs”).

77. Ellerman & Buchner, *supra* note 73, at 285.

78. *Id.* at 286 (Stating that the program induced emissions reductions of between 50 and

found it unlikely that any abatement had occurred, instead attributing the surplus wholly to overallocation.⁷⁹

While Phase 1 of the EU ETS was overallocated and ineffective in establishing an allowance price that could lead to sustained emissions reductions, it can be considered a success in setting the stage for Phase 2 of the EU ETS. The EU retained discretion to fully adjust the program cap for Phase 2 after assessing the performance of the program in Phase 1, and, as described above, 13% fewer allowances on an average annual basis were allocated in Phase 2.⁸⁰ As Phase 2 began, commentators observed that “the trading infrastructure of markets, registries and monitoring, reporting and verification is in place, and a significant segment of European industry is incorporating the price of CO₂ emissions into their daily production decisions.”⁸¹ Phase 1 thus laid the groundwork to enable a potentially more stringent phase of the EU ETS.⁸²

B. Early Overallocation

Other cap-and-trade programs, including RECLAIM and the ARP, are characterized by early overallocation, wherein the program caps were above BAU emissions only in their early years. In later years of the program, the caps were set at levels that were expected to constrain BAU emissions and create conditions of scarcity.

In RECLAIM, annual allowance allocations were above BAU for several years. For the first five years of the program, 1994 through 1998, allocations were in excess of the participating sources’ 1993 emissions. As described in a 2007 report by the South Coast Air Quality Management District, “The RECLAIM program design intentionally led to higher allocations than actual emissions during

100 million tons in each of the years of 2005 and 2006).

79. See Claudia Kettner et al., *Stringency and Distribution in the EU Emissions Trading Scheme—The 2005 Evidence*, Working paper, Fondazione Eni Enrico Mattei, February 2007.

80. See Ellerman & Joskow *supra* note 59, at 45 (stating that the primary goal of Phase 1 was to “develop the infrastructure and provide the experience to enable” the success of Phase 2).

81. *Id.*

82. Observing the whole EU ETS program and assuming that Phase 2 is not also overallocated, the EU ETS could be an example of early rather than absolute overallocation. However, as a self-contained cap-and-trade program independent of Phase 2, Phase 1 serves here as an example of the latter.

the first few years of the program because of concerns that facility production fluctuates from year to year and there was a desire not to lock in production levels during a recessionary period.”⁸³ The report also states that SCAQMD staff did not expect the amount of overallocation to be as high as it was.⁸⁴

Data from the ARP also suggest that caps in the first couple years were above BAU. The EPA reports that Phase I sources emitted 8.7 million tons of SO₂ in 1990, and the cap set for 1995 was also 8.7 million tons.⁸⁵ Importantly, studies show that SO₂ emissions were falling between 1990 and 1995 due to economic factors unrelated to the ARP. In particular, many Midwestern power plants began to use low-sulfur western coal instead of high-sulfur local coal. Doing so became more economically feasible after transport costs fell because of railroad deregulation.⁸⁶ One study found that SO₂ emissions from the 263 coal-fired power plants designated in Table A fell by 13% between 1990 and 1993 due primarily to the changes in the economics of coal choice.⁸⁷ Given this trend, it is very plausible that BAU emissions were lower than the caps set for the early years of the program.

C. Effects of Overallocation

Overallocation, whether absolute or early, leads to predictable outcomes in the operation of a cap-and-trade program. Most directly, it leads to low allowance prices. As will be discussed below, lower allowance prices imply fewer emissions reductions. Under certain circumstances, allowances prices may collapse, making allowances almost worthless and greatly limiting the extent to

83. OVER A DOZEN YEARS OF RECLAIM, *supra* note 33, at III-1-3.

84. *Id.*

85. ACID RAIN PROGRAM REPORT 2001, *supra* note 23, at 5. It should be noted that the number reported for emissions from Phase I sources in 1990—9.989 million tons—is lower than the number reported for Phase I emissions in this year. MARKETS FOR CLEAN AIR, *supra* note 10, at 332 tbl.A.3. The number, however, is consistent with the number reported for Table A emissions. *Id.* at 332 tbl.4.1. It is thus possible that EPA erroneously reports the emissions of Table A facilities as the total Phase I emissions in its Annual reports. Even if the figures reported are accurate, the argument stands that the first couple years of caps in Title IV may have been overallocated with respect to business as usual as observed by a comparison of the trend of actual emissions before 1994 with the 1995 and 1996 caps.

86. Swift, *supra* note 1, at 336.

87. A. Denny Ellerman & Juan-Pablo Montero, *The Declining Trend in Sulfur Dioxide Emissions: Implications for Allowance Prices*, 36 JOURNAL OF ENVTL. ECON. AND MGMT. 26, 29 tbl. I, 43 (1998).

which the program creates incentives for emissions reductions. Moreover, when a cap-and-trade program provides for banking, overallocation can result in the buildup of a large allowance bank that allows emissions beyond the emissions caps set for future years. In these ways, overallocation reduces the environmental effectiveness of cap-and-trade programs.⁸⁸

Some commentators view early overallocation as an acceptable way of gaining political support for a new cap-and-trade program.⁸⁹ Under this argument, as long as the overallocation ends after several years and the program caps become constraining, the overallocation is a reasonable tradeoff for getting sources to agree to the program.⁹⁰ Evidence from existing programs suggests, however, that there are significant operational and environmental costs of early overallocation.

1. Low Allowance Prices

The prices of allowances in existing cap-and-trade programs have been lower than anticipated for much of their lifetimes, and price collapses have plagued several programs. While many factors may influence allowance prices, “the total cap level arguably is the single most important factor and the one most directly under the influence of policymakers.”⁹¹ Overallocation leads to a lack of scarcity of allowances in the allowance market, with the result that allowance prices tend to be depressed and may be subject to collapse.

In economic terms, the market price of an allowance reflects the marginal cost of abatement at the quantity of emissions allowed by

88. An environmentally effective program is one that adequately addresses the environmental problem. *See* Johnstone & Tietenberg, *supra* note 72, at 11 (stating that environmental effectiveness and economic efficiency are the two principal criteria by which any environmental policy should be assessed).

89. *See, e.g.*, A. Denny Ellerman, *US Experience with Emissions Trading: Lessons for CO₂ Emissions Trading*, in EMISSIONS TRADING FOR CLIMATE POLICY: US AND EUROPEAN PERSPECTIVES 90 (Bernd Hansjurgens ed., 2005) (asserting that it is acceptable to use allowance allocation to get political consent and that it does not detract from program goals).

90. In addition, some commentators view one early overallocation positively because it contributes to the establishment of an allowance bank that may help improve allowance price stability later in the program. *See, e.g.*, Harrison et al., *supra* note 6, at 10377. *But see* Ellerman & Joskow, *supra* note 59, at 41 (stating that the existence of a large bank in the ARP failed to moderate a spike in allowance prices that occurred in 2005).

91. Harrison et al., *supra* note 6, at 10376.

the cap.⁹² Sources collectively “reveal their costs of controlling pollution through the allowance price.”⁹³ As such, a lower-than-expected allowance price could result from unanticipated declines in the cost of making emissions reductions. If it suddenly becomes less expensive for sources to install a certain technology that reduces emissions, then the price that they will pay to acquire an allowance instead of reducing emissions accordingly falls. In its annual reports on the ARP, the EPA has often made statements like the “marginal cost of reducing a ton of SO₂ from the utility sector should be reflected in the price of an allowance,”⁹⁴ and “[t]he price of allowances has reflected [] declines in control costs.”⁹⁵ Evidence from existing programs, however, suggests that allowance prices often tend to be low because of an overly ample supply of allowances rather than because of unanticipated declines in abatement costs.

Price collapses have occurred in both programs that are absolutely overallocated and programs that suffer from early overallocation. During the design of ERMS, the Illinois EPA had predicted a price of \$344 per allowance.⁹⁶ Instead the allowance prices averaged about \$75 per allowance in 2000 and steadily declined, reaching an average of \$14 per allowance in 2005.⁹⁷ In Phase 1 of the EU ETS, prices were first higher than the expected 8 to 12, but then collapsed in April 2006 with the news that most EU states produced fewer tons than allocated.⁹⁸ In the months that followed, prices declined from about 30 to 15.⁹⁹ By February 2007, prices fell to less than 1 where they remained for the duration of Phase 1.¹⁰⁰

92. See Debra Israel, *Environmental Participation in the U.S. Sulfur Allowance Auctions*, 38 ENV'T. RESOURCE ECON. 380 (2007) (suggesting that the overall cap on sulfur emissions in the ARP was higher than the optimal emissions level).

93. Evans & Kruger, *supra* note 48, at 20.

94. ACID RAIN PROGRAM REPORT 2000, *supra* note 17, at 10. See also OZONE TRANSPORT COMMISSION, NOX BUDGET PROGRAM, 1999–2002 PROGRESS REPORT, EPA-R-430-03-900 4 fig.2, 17 (March 2003) (stating that “the price of allowance should indicate the highest cost (the marginal cost) that a source would have to pay to reduce an additional ton of NOx.”).

95. ACID RAIN PROGRAM REPORT 1995, *supra* note 13, at 9.

96. Evans & Kruger, *supra* note 48, at 23.

97. *Id.* at 30 tbl. 3. See also Kosobud et al., *supra* note 48, at 35 (stating “the steady decline in average price . . . is a trend and level that no one would have predicted at the start . . .”).

98. Ellerman & Joskow, *supra* note 59, at 12–15.

99. *Id.* at 13.

100. See *id.* at 14–15. It is worth noting that although the price of Phase I allowances collapsed, the trading of Phase 2 allowances since 2005 has established a market price of

In the early years of RECLAIM, prices also essentially collapsed. In the first two years of the program, the allowance price averaged \$28 per ton despite the prediction that allowance prices in these years would average \$577 per ton.¹⁰¹ In the next three years, 1996 through 1998, allowances averaged \$277 per ton in comparison to a predicted average price of \$9151.¹⁰² Studies of RECLAIM have shown that its early overallocation was partly responsible for the allowance market failure that occurred in conjunction with the California electricity crisis in 2000. With overallocation, sources became accustomed to the idea that they would be able to buy allowances at low prices whenever necessary and avoided installing pollution control equipment throughout the 1990s.¹⁰³ As SCAQMD stated, the high initial allocations “resulted in a sense of complacency by many facilities and reduced the pressure to install controls.”¹⁰⁴

In such situations of overallocation, the allowance price will merely reflect the cost of the transaction. A source may still want to buy allowances because it is short of allowances even though there are many more allowances allocated than are needed to cover program emissions. In this situation, “there are plenty of sources that want to sell allowances [and] the exchange price reflects the cost of the transaction and not the value of the allowance.”¹⁰⁵ In effect, lower than predicted allowance prices do not reflect a decline in the cost of controlling pollution if the cap is not set at a level that makes participants reduce their emissions.

The prices of ARP allowances were also significantly lower than predicted in the program’s early years. At the time the legislation

about \$20. *Id.*

101. See EPA, AN EVALUATION OF THE SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT’S REGIONAL CLEAN AIR INCENTIVES MARKET—LESSONS IN ENVIRONMENTAL MARKETS AND INNOVATION 44 (2002) (stating that the average allowance price in 1994 was \$26); SCAQMD, ANNUAL RECLAIM AUDIT REPORT FOR THE 1995 COMPLIANCE YEAR (1997) (stating that average allowance price in 1995 was \$30) [hereinafter RECLAIM AUDIT 1995]. For the predictions of allowance prices, see SCAQMD, RECLAIM PROGRAM THREE-YEAR AUDIT AND PROGRESS REPORT 1998, 4-5 fig. 4-3 [hereinafter THREE-YEAR AUDIT].

102. See RECLAIM AUDIT 1995, *supra* note 92 (stating that average allowance price in 1996 was \$154 per ton); SCAQMD, ANNUAL RECLAIM AUDIT REPORT FOR THE 1997 COMPLIANCE YEAR (1999) (stating that average allowance prices in 1997 and 1998 were \$227 and \$451, respectively), available at <http://www.aqmd.gov/hb/1998/980539a.html>. On the projected prices of allowances, see THREE-YEAR AUDIT, *supra* note 101, at 4–11 fig. 4-3.

103. McAllister, *supra* note 38, at 293–95.

104. OVER A DOZEN YEARS OF RECLAIM, *supra* note 33, at EX-2.

105. Evans & Kruger, *supra* note 48, at 20.

was passed, predictions of allowance prices ranged from \$290 to \$410 in Phase I and from \$580 to \$815 in Phase II.¹⁰⁶ In the first months of the program in 1995, the value of allowances ranged from \$130 to \$140, and most experts expected that prices would rise.¹⁰⁷ In early 1996, however, they declined to as low as \$67.¹⁰⁸ The price decline followed EPA emissions reports indicating that Phase I sources would have many more allowances than they needed to cover their emissions and would be able to bank extensively.¹⁰⁹ Studies show that about two-thirds of the emissions reductions made by sources in Phase I were achieved through “fuel-switching;” that is, firms reduced their emissions by blending or switching from high-sulfur coal to low- or medium-sulfur coal.¹¹⁰ In the years 1997 through 2003, the price of an allowance fluctuated between \$95 per ton and \$210 per ton, averaging approximately \$150.¹¹¹

The ARP illustrates that the severity of the effect of overallocation on allowance prices may also be contingent on other characteristics of the program, particularly a program’s banking provisions. In a program that either does not include banking or includes banking only over a period in which it is likely that supply will remain greater than demand, overallocation is likely to lead to a collapse in allowance prices. The experiences of Phase I of the EU ETS, ERMS, and the first five years of the RECLAIM program typify this

106. Denny Ellerman, *From Autarkic to Market-Based Compliance: Learning from Our Mistakes*, in *EMISSIONS TRADING: ENVIRONMENTAL POLICY’S NEW APPROACH* 195 fig.8.1 (Richard F. Kosobud ed., 2000) (providing ranges in 1995 dollars). In its compliance reports for 1996, 1997, 1998, 1999, and 2000, EPA states that the prices ranged from \$400 to \$1000 per ton (in 1990 dollars).

107. Ellerman, *supra* note 106, at 194.

108. *Id.*

109. *Id.* at 196 (“Instead of a utility scramble for allowances and low sulfur coal, more allowances were going to be available than had been expected.”).

110. Swift, *supra* note 1, at 329. The costs of ARP compliance were significantly lower than expected because the price premium that lower-sulfur coals had historically commanded collapsed in the early 1990s. See Ellerman, *supra* note 106, at 194. The most important factor in the price decline of low-sulfur fuels was railroad deregulation in the 1980s that made large quantities of low-sulfur coal from the Powder River Basin (PRB) in Wyoming available to Midwestern power plants at prices lower than they had historically paid for local coal. See Swift, *supra* note 1, at 338–39; *MARKETS FOR CLEAN AIR*, *supra* note 8, at 80, 82–89 (see especially Table 4.3, showing that the price of PRB coal delivered to the Midwest in 1993 was lower than the price of Midwestern coal in 1993 and in 1987.)

111. EPA, *ACID RAIN PROGRAM: 2003 PROGRESS REPORT 5* (2004) (Incorporating the data from the EPA progress reports from the years 1997 to 2003), available at <http://www.epa.gov/AIRMARKETS/progress/docs/2003report.pdf>.

outcome. By contrast, in a program that includes unlimited banking and an expectation that caps will be more stringent in the future, overallocation does not necessarily lead to a price collapse. Banking provides present value to allowances that would otherwise have little or no present value, as participants hold them or buy them with the expectation that they will be worth more in the future.¹¹²

In the ARP, allowance prices have thus been highly responsive to changes in expectations about future demand for allowances. Most notably, when regulators take action that would decrease SO₂ emissions, and thus weaken future demand for allowances, the allowance prices have declined. For example, prices fell in 1999 and 2000 when the EPA announced and settled enforcement lawsuits against coal-fired power plants under the New Source Review provisions of the Clean Air Act, and then began to climb in late 2002 as the Bush administration weakened New Source Review laws and dropped enforcement suits.¹¹³ In 2005, allowance prices doubled over the course of a year because EPA's Clean Air Interstate Rule (CAIR) indicated that a more stringent cap-and-trade program would be put in place by 2010.¹¹⁴ Allowance prices fell again after 2006 as market participants reevaluated the likely effects of CAIR,¹¹⁵ and then declined precipitously in 2008 after CAIR was vacated by the D.C. Circuit.¹¹⁶

112. B. Hansjurgens, *The Sulfur Dioxide Allowance-Trading Program in the USA: Recent Developments and Lessons to be Learned*, 16 ENV'T AND PLAN. C: GOV'T AND POL'Y 341, 355 (1998) (stating that the price of allowances in the ARP reflects future scarcity rather than present scarcity).

113. See Environmental Finance, *Success in the US*, Oct. 2004, <http://www.environmental-finance.com/2004/0410oct/emission.htm> (last visited March 26, 2009).

114. Ellerman & Joskow, *supra* note 59, at 41; Environmental Finance, *Wrestling with Regulations*, Dec. 2005–Jan. 2006, <http://www.environmental-finance.com/2005/0512dec/surv2.htm> (last visited March 26, 2009); EPA, ACID RAIN PROGRAM: 2005 PROGRESS REPORT 8–9 (2006) (showing that the price of allowances reached about \$1550 by late 2005).

115. ACID RAIN PROGRAM REPORT 2005, *supra* note 114, at 8. By June 2006, the price had again decreased significantly to about \$600 and it generally continued to decline through 2007 and early 2008. *Id.* See also Michael Bologna, *Prices of Sulfur Dioxide Allowances Continue to Slide in Acid Rain Auction*, 39 ENV'T REP. (BNA) 67 (2008).

116. After the D.C. Circuit's decision in *North Carolina v. EPA*, 531 F.3d 896 (D.C. Cir. 2008), which vacated CAIR in July 2008, allowance prices immediately fell by about two-thirds to reach \$100 per ton. EVOLUTION MARKETS, SO₂ MARKETS—JULY 2008, MONTHLY MARKET UPDATE 1 (2008), available at http://new.evomarkets.com/scripts/getmmu.php?mmu_id=349.

2. Delays in Emissions Reductions

The problem with several existing cap-and-trade systems is that they have not generated high enough allowance prices to trigger significant emissions reductions. When low allowances prices prevail, less abatement is economically justified.¹¹⁷ Only emissions reductions that cost less than buying an equivalent number of allowances on the market can be expected, and if the allowance price is low, then few emissions reductions will fall under that bar.

While VOM emissions in Chicago declined over the lifetime of ERMS, analyses have made clear that ERMS was not responsible. An empirical study of the program revealed that “few if any new control technologies were installed. The excess of tradable permits and their low price provided little incentive for control measure innovations.”¹¹⁸ The ERMS cap-and-trade program was designed with such extensive overallocation that it was not as stringent as existing conventional regulation, which made it redundant and environmentally ineffective. According to some commentators, “While emissions reduction surpassed air quality goals assigned to the cap-and-trade market, they were brought about by technology-based command-and-control regulations and not by market incentives.”¹¹⁹

In RECLAIM, early overallocation and resultant low allowance prices led some sources to cancel the installation of previously planned pollution control technologies.¹²⁰ Before the first announcement of allowance prices, electric generating plants regulated under RECLAIM had scheduled installation of nine selective catalytic reduction (SCR) units.¹²¹ Within two months of allowance price disclosures, these plants had put seven SCR units on hold and cancelled the other two.¹²² Within a year, the plants had cancelled them all.¹²³ Had RECLAIM not subsumed a SCAQMD rule that required all power plants to install SCR units by

117. Cf. Ellerman, *supra* note 106, at 196–97, 199 (stating that “[l]ower allowance prices justify less current abatement.”).

118. Kosobud et al., *supra* note 48, at 9 (reporting on survey fully described in Chapter 6).

119. *Id.* at 100.

120. CLEAN AIR ACTION CORPORATION, US EXPERIENCE WITH EMISSIONS TRADING 49–50 (2002).

121. *Id.* at 49.

122. *Id.*

123. *Id.*

2000,¹²⁴ other units would have also been installed, and the emissions over the cap that occurred under the program in 2000 and 2001 during the electricity crisis “would have been largely avoided.”¹²⁵

Trends in emissions reductions before and after the implementation of the RECLAIM program cap suggest a slow down in emissions reduction. Emissions by participating sources fell by 38% in the five-year period between 1989 and 1993, but only 18% in the eight year period between 1993 and 2000.¹²⁶ It could perhaps be argued that the cheap and easy “low-hanging” emissions reductions occurred under the traditional regulation in the years prior to RECLAIM, but evidence contradicts this contention. When traditional regulation was reinstated after RECLAIM was partially dismantled in 2001, plants achieved very significant reductions in emissions for a reasonable cost.¹²⁷

In the midst of the crisis of the RECLAIM program in 2000, SCAQMD prepared an analysis of technologies available to reduce NOx emissions. The analysis determined that the installation of control technologies at about a third of RECLAIM sources was necessary to achieve the 2003 program cap.¹²⁸ The study further yielded an overall cost-effectiveness of \$3300 per ton of NOx using these control technologies, approximately fourteen times less than the average price of a RECLAIM allowance on the market in that year.¹²⁹ Given that the market had not spurred these cost-effective

124. SCAQMD, *Rule 1135—Emissions of Oxides of Nitrogen from Electric Power Generating Systems* (1991), available at <http://www.aqmd.gov/rules/reg/reg11/r1135.pdf>. The rule required selective catalytic reduction on power plants by the year 2000, but was subsumed by RECLAIM for participating sources. OVER A DOZEN YEARS OF RECLAIM, *supra* note 33, at I-4-2. For a complete list of the rules that RECLAIM subsumed, see SCAQMD, RECLAIM VOLUME I: DEVELOPMENT REPORT AND RULES at 2-9 to 2-10 tbl.2-1 (1993) (listing 17 rules from which RECLAIM NOx facilities were exempted in full or in part).

125. OVER A DOZEN YEARS OF RECLAIM, *supra* note 33, at I-4-2.

126. See THREE-YEAR AUDIT, *supra* note 101, at 3-5 fig. 3-3 (showing that approximately 40,000 tons of NOx were emitted in 1989). *But see id.* at 8-8 to 8-9 (asserting that although significant emissions reductions had been achieved at a reasonable cost historically, “in the early 1990s it became apparent that limited opportunities for additional emissions reductions remained available to this approach . . .” and “there is no assurance that the downward trends experienced during the 1980s and the first years of the 1990s would have continued under the command-and-control regime.”).

127. See *supra* notes 43–45, and *infra* notes 128–26, and accompanying text.

128. SCAQMD, WHITE PAPER ON STABILIZATION OF NOx RTC PRICES 2, 25 (2001) (citing need for installation at 120 sources and stating that 364 sources are in the RECLAIM universe).

129. *Id.* at 25.

emissions reductions, SCAQMD opted to remove the largest emitters from the program and subject them to a Best Available Retrofit Technology requirement.¹³⁰ As a result, their emissions declined 90% between 2000 and 2004, and emissions met the program's 2003 cap.¹³¹

The ARP, in contrast to RECLAIM and other programs, did achieve significant reductions in its first year and thus illustrates that programs with early overallocation may still be effective in reducing emissions. In 1995, Phase I sources emitted 39% fewer emissions than the allowances they were allocated. While some of this allowance surplus was likely the result of a first year cap that overallocated allowances with respect to BAU, the majority of it was due to emissions reductions from BAU levels. Firms achieved the reductions by switching to lower sulfur coal (59%); installing scrubbers (35%), and retiring units (6%).¹³² Under the ARP, sources were motivated to reduce their emissions at the beginning of the program by their ability to bank unused allowances, which were likely to become more valuable in the more stringent Phase II.¹³³

While one cannot doubt that the ARP spurred a significant drop in SO₂ emissions in its first year, it is worth noting that emissions from Phase I sources tended to increase during the remainder of Phase I. When the ARP allowance prices fell to as low as \$67 in early 1996, some utilities that had shifted to low-sulfur coal shifted back to high-sulfur coal.¹³⁴ In light of low allowance prices, some utilities also cancelled installations of scrubbers.¹³⁵ According to one report, no regulated sources scheduled installation of

130. Compliance Plan for Power Producing Facilities, AQMD Rule 2009 (May 11, 2001, amended Jan. 7, 2005).

131. SCAQMD, ANNUAL RECLAIM AUDIT REPORT FOR 2004 COMPLIANCE YEAR 3-4 tbls. 3-2 & 3-3 (2006).

132. Swift, *supra* note 1, at 328–29.

133. *Id.* at 325–36.

134. Ellerman, *supra* note 106, at 194, 199 (showing also that the average SO₂ emission rate for the 386 nonscrubbed units that were subject to Phase I in both 1995 and 1996 increased by 4.6%). Moreover, although the Acid Rain Program was reportedly intended to send a price signal to electric utilities such that the oldest and dirtiest coal-fired plants would be retired, this did not occur. Only seven of the original 263 units, constituting 1.5% of the total plant capacity were retired in the first few years of the program. Shi-Ling Hsu, *Reducing Emissions from the Electricity Generation Industry: Can we Finally Do It?*, 14 TUL. ENVTL L.J. 427, 435 n.111 (2001) (stating that “[e]vidently, the price signal was not strong enough.”).

135. Ellerman, *supra* note 106, at 198 n.7. Even though scrubbers were not as expensive as predicted, buying allowances was much cheaper. See Swift, *supra* note 1, at 330–35.

scrubbers during the first six years of the ARP.¹³⁶ An analysis by public interest organizations found that 60% of power plants in the ARP increased their SO₂ emissions between 1995 and 2000.¹³⁷

Commentators often posit that cap-and-trade regulation provides greater incentives for innovation in emissions reductions technology than conventional regulation because firms have more flexibility in making compliance decisions.¹³⁸ Empirical evidence from existing programs, however, does not tend to support this proposition. Both emissions trading and conventional regulation have “sometimes encouraged innovation and sometimes failed to” and convincing evidence of the former’s superiority is lacking.¹³⁹ In fact, a detailed study of the history of innovation in SO₂ control technology found much more significant innovation under the conventional environmental regulations of the 1970s than under the ARP.¹⁴⁰ Indeed, the lack of innovation under the ARP and other cap-and-trade programs may be due to their absolute or early overallocation and associated lack of stringency.¹⁴¹ It is also worth noting that allowance prices in existing programs have been volatile.¹⁴² Such volatility may tend to undermine investment in the

136. Clean Air Action Corporation, *supra* note 120, at 49.

137. REBECCA STANFIELD, U.S. PIRG EDUCATION FUND, DARKENING SKIES: TRENDS TOWARD INCREASING POWER PLANT EMISSIONS (2002). *Cf.* Ellerman, *US Experience with Emissions Trading*, *supra* note 89, at 92 n.4 (criticizing the U.S. PIRG Report).

138. *See, e.g.*, Margaret R. Taylor et al., *Regulation as the Mother of Innovation: the Case of SO₂ Control*, 27 LAW & POL’Y 348, 349–50 (2005); Byron Swift, *U.S. Emissions Trading: Myths, Realities, and Opportunities*, 20 NAT. RESOURCE & ENV’T 3, 7 (2005); David M. Driesen, *Design, Trading, and Innovation*, in MOVING TO MARKETS IN ENVIRONMENTAL REGULATION: LESSONS FROM TWENTY YEARS OF EXPERIENCE 436 n.3 (Jody Freeman & Charles D. Kolstad eds., 2007) [hereinafter Driesen, *Design Trading, and Innovation*]. *But see* DAVID M. DRIESEN, THE ECONOMIC DYNAMICS OF ENVIRONMENTAL LAW 64 (2003) (arguing that cap-and-trade programs “weaken net incentives for innovation” because they imply an equal measure of incentives for under-compliance as over-compliance); David A. Dana, *Commodifying and Banking Pollution Rights, Reducing Innovation* (Northwestern University School of Law, Law and Economics Research Paper Series, Research Paper No. 05-04, 2005) (arguing that sources that have banked allowances have a disincentive to develop and diffuse new emissions reduction technologies because of the predictably negative impact on the value of their banked allowance).

139. Driesen, *Design Trading, and Innovation*, *supra* note 138, at 453.

140. Taylor et al., *supra* note 138, at 370; *see also* Driesen, *Design Trading, and Innovation* *supra* note 138, at 452–53.

141. Taylor et al., *supra* note 138, at 350–51 (arguing that stringency is associated with higher levels of innovation).

142. *See* CONGRESSIONAL BUDGET OFFICE (CBO), POLICY OPTIONS FOR REDUCING CO₂ EMISSIONS 7 (2008) (citing William D. Nordhaus, *To Tax or Not to Tax: Alternative Approaches to Slowing Global Warming*, 1 REV. OF ENV’T L. EC. AND POL’Y 26 (2007) (showing that the price of

installation of existing emissions reductions technology and the development of new emissions reductions technology.¹⁴³

One response to the criticism that overallocated caps allow for an increase in emissions from BAU is to point out that overallocated caps in existing programs have not, in fact, led to increases in emissions. Economic theory, in contrast, suggests that if sources have too much of an asset such as pollution allowances, they will find a use for the asset and emit more pollution. A commentator on ERMS thus cites the fact that sources allowed permits to expire unused as “among the most perplexing problems of reported market activity,” raising the “question of why emitters did not increase emissions, which could then be covered by unused permits.”¹⁴⁴ Similarly, in the context of RECLAIM, a commentator draws attention to the fact that the lenient caps in the early years of the program did not lead to emissions increases.¹⁴⁵ The fact that higher emissions did not occur in these programs when economic theory predicted they would, however, is no cause for celebration. It would be quite unacceptable if a new form of environmental regulation created to reduce emissions increased them instead.

3. Large Allowance Banks

Where unlimited banking is available, as in the ARP, overallocation may result in the buildup of a large allowance bank. If more allowances were allocated than needed to cover BAU emissions, then banked allowances will not represent emissions reductions induced by the program, but they will allow sources to emit more in the future.¹⁴⁶ While the literature has emphasized the usefulness of banking as an “accelerator” of emissions reductions in the early years of a program, banking may also serve as a potential

SO₂ allowances in the ARP was significantly more volatile than stock prices between 1995 and 2006); On the EU ETS, see Regina Betz, *What is driving Price Volatility in the EU ETS?*, in AUSTRALIAN EMISSIONS TRADING FORUM REVIEW 4–5 (2006).

143. Alice Kaswan, *Environmental Justice and Domestic Climate Change Policy*, 38 ENVTL. L. REP. NEWS & ANALYSIS 10287, 10297 (stating that “the price signal must be steady and clear to justify the long and expensive process of research and development”); see also CBO, *supra* note 142, at 7.

144. Kosobud et al., *supra* note 48, at 34

145. Harrison, *supra* note 33, at 50.

146. See, e.g., Dallas Burtraw, *Appraisal of the SO₂ Cap-and-Trade Market*, in EMISSIONS TRADING: ENVIRONMENTAL POLICY’S NEW APPROACH 162 (Richard F. Kosobud, ed., 2000) (indicating that the value of SO₂ allowances given to Phase I firms under the ARP far outweighed their compliance costs).

decelerator of emissions reductions in later years.¹⁴⁷

Banked allowances have a future environmental cost: they make emissions beyond the level of future program caps legally permissible. Banking is thus in tension with cap-and-trade's promise of a reliable upper limit on emissions.¹⁴⁸ The ARP provides the best example. By the end of Phase I in 1999, participants had banked about 11.5 million tons worth of allowances, more than the number of allowances needed to cover two years worth of their emissions.¹⁴⁹ According to Table 1, In 2000, the first year of Phase II, the ARP allocated about 10 million tons in allowances, but sources emitted 11.2 million tons (12% over the cap). In all years of Phase II except 2006, emissions have exceeded the annual allocations by at least 7%.¹⁵⁰

Banking is often lauded as an "accelerator" of emissions reductions that induces companies to undertake them early in the program.¹⁵¹ In the ARP, the ability to bank allowances surely motivated the significant reduction of emissions from BAU in the first year of the program. Banking, however, should also be viewed as a decelerator that leads to fewer emissions reductions in later program years. The degree of banking that occurred in the ARP in its early years reduced the program's later environmental benefits. If the pre-1995 expectations for banking had been correct in the ARP, the cumulative bank at end of Phase I would have been about 6 million tons; instead, it was 11.6 million tons.¹⁵² Emissions that could have been avoided, in 2003 perhaps, when the smaller bank would have run out, were delayed for several more years.¹⁵³ The extent of banking that occurred in the ARP makes it less likely that the program will achieve its statutory goal that there be no more than 8.95 million tons of SO₂ emissions in 2010.¹⁵⁴ While experts

147. See *infra* note 151 and accompanying text.

148. *Id.* at 138–39.

149. See ACID RAIN PROGRAM REPORT 2004, *supra* note 8, at 5. For a comparison of predictions of how much banking would occur and the reality see Ellerman, *supra* note 106, at 196–197.

150. In 2006, emissions fell sharply due to reduced energy demand, decreased use of oil because of high fuel prices, and early compliance with the anticipated Clean Air Interstate Rule. ACID RAIN PROGRAM REPORT 2006, *supra* note 17, at 3, 11.

151. See Ellerman, *US Experience with Emissions Trading*, *supra* note 89, at 84; Burtraw, *supra* note 146, at 138.

152. Ellerman, *supra* note 106, at 200.

153. *Id.*

154. See Chestnut & Mills, *supra* note 7. The authors estimate that there will instead be

had previously expected the bank of allowances to be used up by 2010,¹⁵⁵ recent estimates suggest that the bank will not be exhausted until several years later.¹⁵⁶

The compliance story of Southern Company in the ARP illustrates how the overallocation of early caps influenced compliance behavior. Of all utilities in Phase I, Southern Company had the greatest number of affected units and the largest allocation of allowances.¹⁵⁷ Southern Company was able to switch to lower sulfur coal while paying “little or no premium” for it.¹⁵⁸ In 1996, ARP allocated 59,842 allowances for the company, and the company was able to bank 26,021 of them.¹⁵⁹ After building its bank throughout Phase I, it planned to continue emitting at the same rate by slowly drawing down its bank.¹⁶⁰

By Contrast, RECLAIM has been criticized for failing to provide for banking.¹⁶¹ Critics assert that if banking had been incorporated into RECLAIM, the effect of the electricity crisis on allowance prices would have been greatly reduced.¹⁶² It is worthwhile, however, to consider how the inclusion of banking in RECLAIM would have affected the program’s environmental effectiveness. If banking had been allowed, sources would have been able to bank over 40,000 allowances by 1999.¹⁶³ Such a bank would indeed have been capable of covering the roughly 3000 tons by which emissions exceeded the annual cap in 2000. But, in this case, there would have been much less impetus to reform the program to achieve the significant declines in emissions that occurred between 2001 and 2003. Of course, it is possible that a decision to include banking in the program would have occurred in tandem with a decision to

9.3 million tons of SO₂ emissions under the program in 2010, noting that these emissions are expected to be above the permanent cap because of the use of banked allowances. *Id.*

155. Burtraw et al., *supra* note 4, at 260 (stating, “In Phase II, emissions have exceeded the annual allowance allocation by 1–1.5 million tons each year by drawing on the allowance bank, which is expected to be exhausted by the end of the decade.”)

156. *Id.* at 254 tbl.1 note b.

157. Gary R. Hart, *Southern Company’s BUBA Strategy in the SO₂ Allowance Market*, in EMISSIONS TRADING: ENVIRONMENTAL POLICY’S NEW APPROACH 204 (Richard F. Kosobud, ed., 2000).

158. *Id.* at 205.

159. *Id.*

160. *Id.* at 206.

161. *See, e.g.*, Ellerman, *supra* note 106, at 87; Stavins, *supra* note 6, at 364–65.

162. Ellerman, *supra* note 106, at 85–86; *see e.g.* Burtraw et al., *supra* note 4, at 276.

163. *See infra* Table 2 (summing the amount of allowances that went unused in program years 1994 through 1999).

reduce the overallocation that characterized the program's early years.¹⁶⁴

III. MOVING TOWARD STRINGENT CAPS

Unless future cap-and-trade programs are more stringent than existing programs, their results are likely to disappoint.¹⁶⁵ Regulators need to make a fundamental shift in the design of cap-and-trade programs if these programs are to become more environmentally effective. As it currently stands, program designers have emphasized protecting regulated sources from economic costs. Moving forward, cap-and-trade programs must be designed with the primary goal of providing environmental benefits. The number of allowances allocated must be such that a strong price signal emerges that engenders technologically and economically feasible emissions reductions and supports technological innovation.¹⁶⁶

A. The Feasibility Principle

Overallocation could be reduced or avoided if caps were set based on the "feasibility principle," which has governed many standard-setting processes under conventional environmental law.¹⁶⁷ Caps should be sufficiently stringent to motivate emissions reductions at least as great as those that could otherwise be achieved by requiring the use of economically and technologically feasible emissions control technologies. In the EU ETS and ERMS,

164. Burtraw et al., *supra* note 4, at 272 (asserting that the anticipation that emissions would be far below allocations "contributed to the decision to prohibit banking."). They further assert that program designers should have reduced allocation rather than eliminating banking. *Id.* at 276.

165. At least one commentator has concluded that cap-and-trade works best when the targets are not too stringent. See Ada Wossink, *The Dutch Nutrient Quota System: Past Experience and Lessons for the Future*, in TRADEABLE PERMITS: POLICY EVALUATION, DESIGN AND REFORM 117 (Organization for Economic Co-operation and Development ed., 2004) (stating that the "Dutch example shows that a tradable permit system as the single policy instrument to achieve policy targets might only work when actual pollution and policy targets are reasonably close.").

166. The question of whether cap-and-trade regulation favors technological innovation to a greater degree than conventional regulation is avidly debated. See *supra* notes 138–140 and accompanying text.

167. See David M. Driesen, *Distributing the Costs of Environmental, Health, and Safety Protection: The Feasibility Principle, Cost-Benefit Analysis, and Regulatory Reform*, 32 BC ENVTL. AFF. LAW REV. 1, 9 (2005).

which were absolutely overallocated as described above,¹⁶⁸ the caps bore little or no relation to measures of feasibility. In RECLAIM and the ARP, measures of feasibility were used to set the later-year caps, and these programs avoided the problem of absolute overallocation.¹⁶⁹

The program cap determines the stringency of a cap-and-trade program. The question of how stringent a cap-and-trade program should be is difficult. It might be asserted that if the caps avoid overallocation with respect to BAU, then the program is sufficiently stringent. In other words, if the program requires any emissions reductions from BAU then it should not be subject to criticism for lack of stringency. Such a position, however, requires judging the stringency of an emissions trading program by low standards and assuming that no alternative regulatory action would have been taken with respect to an environmental problem.

Rather, a cap-and-trade program's stringency should be judged by the feasibility principle as described by Professor Driesen.¹⁷⁰ That is, the program should be judged by its capacity to induce the maximum technologically and economically feasible emissions reductions. The feasibility principle animates numerous major environmental laws and demands that regulation be stringent subject to the constraints that it also be technologically and economically feasible.¹⁷¹ Examples of such regulation include standards based on "lowest achievable emission rate" or "best available control technology," under the Clean Air Act, and "best available demonstrated control technology" or "best available technology" under the Clean Water Act.¹⁷²

In programs governed by these technology-based standards, the agency conducts a feasibility analysis in which it identifies pollution reduction technologies, assesses the extent to which they reduce pollution, and estimates their associated costs.¹⁷³ The agency then selects a control technology and establishes a quantitative

168. *See supra* notes 87–91 and accompanying text.

169. *See supra* notes 74–78 and accompanying text.

170. Driesen, *supra* note 167.

171. *Id.*

172. *Id.* at 20–21. *See also* Jason Scott Johnston, *Tradable Pollution Permits and the Regulatory Game*, in *MOVING TO MARKETS IN ENVIRONMENTAL REGULATION: LESSONS FROM THIRTY YEARS OF EXPERIENCE* 353 (Charles Kolstad & Jody Freeman eds., 2007) (stating that federal statutes have told regulators to "base pollution standards on what is technologically and economically achievable.").

173. Driesen, *supra* note 167, at 12.

performance standard at the level of pollution reduction the technology would achieve.¹⁷⁴ Agencies are required to adopt stringent standards, subject to the constraint that the technology necessary to meet the standard is not so costly as to cause widespread plant shutdowns.¹⁷⁵ In essence, under the feasibility principle, the right level of stringency is the level that makes polluters reduce their pollution as much as possible without causing an economic crisis in the industry.

As Professor Driesen points out, regulators can use the feasibility principle to set the cap in an emissions trading system as well. As has been done in the past, the agency would collect and analyze the information necessary to make an expert judgment regarding the technological and economic feasibility of emissions reductions at the facilities included in the cap-and-trade program.¹⁷⁶ The programs caps would then be set at levels that would ensure that emissions reductions are at least as great as those that would be achieved by mandating the use of feasible emissions controls.¹⁷⁷

In both RECLAIM and the ARP, feasibility played a role in setting program caps for the latter years of each program. California law required that RECLAIM caps be established such that the program would achieve the maximum feasible emissions reductions. The California Clean Air Act required the state's air districts to achieve and maintain state standards by the earliest practicable date, and for extreme non-attainment areas such as the Los Angeles air district, to include all feasible measures.¹⁷⁸ Provisions of the California Health and Safety Code specifically enacted in anticipation of RECLAIM also required that market-based regulation "result in an equivalent or greater reduction in emissions at equivalent or less cost compared with current command and control regulations and future air quality measures that would otherwise have been adopted as part of the district's plan for attainment."¹⁷⁹ The designers of RECLAIM sought to meet

174. *Id.* at 17–18.

175. *Id.* at 9.

176. *See, e.g.,* TOOLS OF THE TRADE, *supra* note 25, at 3-9 (noting that an approach sometimes used by policymakers to determine the aggregate emissions cap is finding the 'knee in the cost curve,' which is the point before costs per unit of emissions reduction begins to rise rapidly).

177. *Cf. Swift, supra* note 1, at 315 (referring to the cap in cap-and-trade as a "mass performance standard").

178. *See* RECLAIM PROPOSED AMENDMENTS 2005, *supra* note 35, at 3.

179. CAL. HEALTH & SAFETY CODE § 39616(c)(1) (West 2006). Similarly, California's

this legal obligation by setting the 2000 and 2003 caps equal to the levels that were expected to be achieved through the conventional regulations that RECLAIM subsumed, as described above.¹⁸⁰

In the ARP, Phase II caps were keyed to the feasibility-based New Source Performance Standard (NSPS) established in 1971 for SO₂ emissions from coal-fired utility boilers. The Clean Air Act's NSPS program required that new sources of pollution meet a standard "which reflects the degree of emission limitation achievable through the application of the best system of emission reduction which . . . the Administrator determines has been adequately demonstrated."¹⁸¹ For coal fired utility boilers, the standard set in 1971 and maintained in subsequent years required that new sources emit no more than 1.2 lbs SO₂/mm BTU. Phase II caps, as described above, were set based on this same emissions rate, though additional allowances were allocated that increased the total cap.¹⁸²

The observation that the Phase II caps were partly determined through considering feasibility, however, does not mean that they were as stringent as the feasibility principle would require. As discussed below, there is evidence that the Phase II caps should have been even more stringent.¹⁸³ Also, it is worth noting that Germany's SO₂ limits for power plants that were implemented through conventional regulatory approaches were much stricter than the emissions rates used to establish the caps in Phases I and II of the ARP.¹⁸⁴ For large sources, German law set a limit of 400 mg SO₂/m³ in 1988 while the U.S. program caps in Phase I were

climate change law, for which an emissions trading system is under development, requires the state board to adopt regulations that "achieve the maximum technologically feasible and cost-effective reductions in greenhouse gas emissions." *Id.* § 38560 (West, Westlaw through Ch. 1 of 2009 Reg.Sess., Ch. 12 of 2009–2010 2nd Ex.Sess., and Ch. 20 of 2009–2010 3rd Ex. Sess.).

180. *See supra* notes 29–33 and accompanying text. Public interest groups suggested in the late 1990s that the program had failed to meet this legal requirement because SCAQMD's data showed that the NO_x allocations for the years 1994, 2000, and 2004 were in most cases above the 1991 and/or 1994 AQMP targets. *See* Comments of Gail Ruderman Feuer, Natural Resources Defense Council, and Tim Carmichael, Coalition for Clean Air, contained in SCAQMD, THREE-YEAR AUDIT, *supra* note 92, at 2–9.

181. Clean Air Act, 42 U.S.C. § 7411(a)(1) (2000).

182. *See supra* notes 17–24 and accompanying text.

183. *See infra* notes 213–240 and accompanying text.

184. Raimund Schwarze, *Incentives to Adopt New Abatement Technology and US-European Regulatory Cultures*, in EMISSIONS TRADING FOR CLIMATE POLICY: US AND EUROPEAN PERSPECTIVES 56 (Bernd Hansjurgens, ed., 2005).

based on a limit of 2800 mg SO₂/m³.¹⁸⁵ Phase II caps were set based on the more stringent limit of 1400 mg SO₂/m³, but this limit was still over three times the limit put into effect in Germany more than a decade earlier and seven times greater than a target established in a European Union directive in 1999.¹⁸⁶

One might argue that, to achieve sufficient stringency, caps ought to be set at the “optimal level of pollution”¹⁸⁷ rather than by the feasibility principle. The socially-optimal or efficient level of pollution occurs where the marginal costs of pollution equal the marginal benefits of pollution. With a cap set to achieve this level, participating sources should abate pollution “to the point at which the marginal cost of removing a ton of pollution equals the social benefit from having that ton removed. In this situation, the economic costs perceived by private firms reflect the overall social and economic value of pollution reduction, creating efficiency in achieving social welfare.”¹⁸⁸ A cap that equalizes social costs and benefits would theoretically get the prices right for emissions of the regulated pollutant.

While setting the cap at the socially-optimal level is a theoretical ideal, the difficulties of fully quantifying social costs and benefits make it impracticable.¹⁸⁹ Early economists writing on emissions trading acknowledged the difficulty of ascertaining the optimal level of pollution and dismissed it. They focused not on how to achieve the socially-efficient level of pollution, but rather how to achieve any governmentally-determined level of pollution in the most cost-effective way.¹⁹⁰ In his groundbreaking 1968 book, J.H.

185. *Id.* at 57 tbl.4.1. The table further indicates that in the US, the limit on large sources is less stringent than on small sources, while the reverse is true under the 1988 German act and under 2001 European Union legislation. Note that, although expressed in different units, these limits correspond to the 2.5 and 1.2 lbs/mm BTU rates cited, *supra* in notes 9–17 and accompanying text. Large sources in the German act and EU directive are defined as sources generating more than 300 MW. Phase I included facilities larger than 100 MW. Parker et al., *supra* note 24, at 2026.

186. Schwarze, *supra* note 184, at 57.

187. TOOLS OF THE TRADE, *supra* note 25, at A1–A2. The concept of a socially-optimal level of pollution derives from Coase’s writings. See R.H. Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1, 41–44 (1960).

188. Swift, *supra* note 1, at 378 n.341.

189. DRIESEN, THE ECONOMIC DYNAMICS OF ENVIRONMENTAL LAW, *supra* note 138, at 21.

190. Lisa Heinzerling, *Selling Pollution, Forcing Democracy*, 14 STAN. ENVTL. L.J. 300, 309–10 (1995). For an early discussion of the difficulty a “control authority” faces in measuring costs and benefits, see Thomas D. Crocker, *The Structuring of Atmospheric Pollution Control Systems*, in THE ECONOMICS OF AIR POLLUTION 77–81 (H. Wolozin, ed., 1966).

Dales asserted that economic analysis could not determine the appropriate policy goal but could reveal the best means to reach that policy goal.¹⁹¹ Feasibility analysis is, thus, in many ways shorthand for a much more complex optimality analysis, and it avoids the need to price the “priceless.”¹⁹² Moreover, feasibility, to a greater extent than full cost-benefit analysis, has been the foundation of standard-setting in the environmental laws under which the existing cap-and-trade programs in the United States have been established.

Clearly, the decision to adopt a cap-and-trade approach does not avoid the classic policy questions of environmental regulation.¹⁹³ The key questions remain regarding the level of reduction necessary to meet the environmental goal, the costs that are justified by the environmental benefits, and the length of time it should take to meet the goal. In a cap-and-trade program, all these questions must be confronted in setting the cap at an appropriately stringent level. The feasibility principle has been useful in determining the appropriate level of stringency in conventional regulation and should be used to help determine sufficiently stringent caps in cap-and-trade programs.

B. Ratcheting Down Initial Caps

Rules that make the overall size of the program cap dependent on the allocation process have contributed to overallocation in several programs.¹⁹⁴ Such overallocation illustrates the importance of “decoupling the allocation process, which determines the distributions of costs between program participants[,] from the overall size of the cap.”¹⁹⁵ The inclusion of a “ratchet” that cuts allowances allocation as necessary to meet an independently-determined cap level is an answer to this problem. In the ARP, Congress included a “ratchet” provision that reduced Phase II

191. J. H. DALES, *POLLUTION, PROPERTY, & PRICES* 39–40, 99, 104–05 (1968).

192. FRANK ACKERMAN & LISA HEINZERLING, *PRICELESS: ON KNOWING THE PRICE OF EVERYTHING AND THE VALUE OF NOTHING* (2004); Driesen, *supra* note 167, at 49–50.

193. See Evans & Kruger, *supra* note 48, at 31.

194. As detailed in Part I, in ERMS, the allowance allocations were summed then reduced by 12%. See *supra* note 46 and accompanying text. In RECLAIM, the first year cap was derived from summing all the individual allocations, and then it was progressively reduced to reach a year 2000 cap based on projected equivalence with the conventional regulations that the program replaced. See *supra* notes 29–32 and accompanying text.

195. Evans & Kruger, *supra* note 48, at 25.

allowance allocations proportionally to ensure that they would sum to a certain legislatively-determined cap.¹⁹⁶ Such ratchet provisions should be used to ensure that the ultimate program caps lead to emissions reductions at least as great as would be achieved by the application of the feasibility principle. Similarly, to prevent early overallocation, a ratchet based on BAU emissions could be applied to the early year caps.

The initial determination of allowance allocations in existing cap-and-trade programs has been very controversial.¹⁹⁷ Participants have a clear incentive to lobby for rules that will increase their allocations. While allocations are nominally based on prior use—some measure of historical emissions or capacity—sources have engaged in a high degree of strategic behavior that has inflated their allocations and the cap as a whole.¹⁹⁸ Where these allocations are then simply summed to determine the overall program cap, as in ERMS and the initial years of RECLAIM, the programs suffered from severe overallocation.

In ERMS, each source's emissions baseline was determined from the average of the two highest summertime emissions from 1994 to 1996.¹⁹⁹ A study of 15 randomly-selected ERMS sources suggested that the sources' ability to select baseline years inflated the baseline by about 5%.²⁰⁰ Moreover, a source could substitute other years between 1990 and 1997 if it successfully argued that the years 1994 to 1996 were atypical. About 22% of participants substituted baseline years, which one can reasonably predict to further inflate the baseline.²⁰¹ Also, in ERMS, the baseline was often determined by considering participants' "allowable emissions" rather than their actual or benchmarked emissions.²⁰² As such, sources could

196. Clean Air Act, 42 U.S.C. § 7651b(a)(1) (2007) ("If necessary to meeting the restrictions imposed in the preceding sentence, the Administrator shall reduce, pro rata, the basic Phase II allowance allocations for each unit subject to the requirements of section 405.").

197. Tom Tietenberg, *Tradable Permits in Principal and Practice*, in *MOVING TO MARKETS IN ENVIRONMENTAL REGULATION: LESSONS FROM THIRTY YEARS OF EXPERIENCE* 80 (Charles Kolstad & Jody Freeman eds., 2007).

198. *Id.* at 81–82. On allowance allocation using historical baselines, see Ellerman & Buchner, *supra* note 59, at 85; see also LEIGH RAYMOND, *PRIVATE RIGHTS IN PUBLIC RESOURCES: EQUITY AND PROPERTY ALLOCATION IN MARKET-BASED ENVIRONMENTAL POLICY* 52–53 (2003); Tietenberg, *supra* note 197, at 80.

199. Evans & Kruger, *supra* note 48, at 24.

200. *Id.* at 25; see also Kosobud *et al.*, *supra* note 48, at 40.

201. Kosobud *et al.*, *supra* note 48, at 40; see also Evans & Kruger, *supra* note 48, at 24–25.

202. Evans & Kruger, *supra* note 48, at 25. With "benchmarking," some index of historical

petition for an allowance allocation based on their permitted emissions with the argument that they had “voluntarily overcomplied” with their permits.²⁰³ According to the Illinois EPA, it made such accommodations to make businesses feel comfortable with the availability of permits.²⁰⁴

In RECLAIM, the chosen baseline years were considered to be recessionary, and industry successfully argued that the allocations should be large enough to allow for growth in production.²⁰⁵ As a result, each facility was allowed to choose its highest production year from the years 1989 to 1992 for its initial allocation in 1994, and its highest production year from the years 1987 to 1992 for its year 2000 allocation.²⁰⁶ Environmental groups argued that this allocation method would overallocate for two reasons. First, the recession had not greatly affected the largest allowance recipients, the electric utilities, and second, because choosing the peak production year rather than averaging over the years led to an aggregate production level higher than any given year.²⁰⁷ It is also worth noting that businesses were permitted to amend the prior year emission reports that would be used to calculate their initial allocations, and many took the opportunity to do so almost exclusively to increase emissions.²⁰⁸

Sources also received “emission reduction credits” (ERCs) if they reduced their emissions prior to program implementation.²⁰⁹ ERCs were reductions in emissions that the agency viewed as being real and permanent, and also constituted surplus beyond mandated reductions.²¹⁰ Any ERCs held by RECLAIM facilities in 1993 were converted to RECLAIM allowances and added to the starting allocation for that facility.²¹¹ Moreover, these converted ERCs did not depreciate annually like the allowances created by the program

activity or capacity is multiplied by a usually uniform emission-rate standard to determine allocations to individual installations. Ellerman & Buchner, *supra* note 59, at 76.

203. Evans & Kruger, *supra* note 48, at 25; Kosobud et al., *supra* note 48, at 40.

204. Kosobud et al., *supra* note 48, at 40.

205. OVER A DOZEN YEARS OF RECLAIM, *supra* note 33, at EX-2.

206. Polesetsky, *supra* note 29, at 387.

207. *Id.* They argued that the yearly production averages should have been averaged as they were in the ARP. *Id.* at 388.

208. OVER A DOZEN YEARS OF RECLAIM, *supra* note 33, at EX-2.

209. *Id.*, at EX-2, I-4-1; Fowlie, *supra* note 29, at 129–30.

210. See RECLAIM Rule 2000(c)(31), available at <http://www.aqmd.gov/rules/reg/reg20/r2000.pdf>.

211. Fowlie, *supra* note 29, at 129–30.

itself until after the year 2000.²¹² SCAQMD has acknowledged that its provisions for ERCs along with participant's ability to choose their baseline years and amend their prior emissions reports contributed to "the inflated start point."²¹³ An observer of the RECLAIM design process explains that the initial allocation of allowances was the most contentious part of program design and the "final set of formulas for allocating [allowances] departed considerably from the simple formula initially proposed by SCAQMD."²¹⁴ Accordingly, "the final result was an administratively feasible and politically salable cap-and-trade program."²¹⁵

In the ARP, the flexibility that Phase I sources were given to designate "substitute units" contributed to early overallocation. Under the program's substitution unit provisions, the program allowed sources with Table A power generating units included in Phase I to designate one or more other power generating units under common ownership to achieve the emissions reductions in the place of the Table A unit.²¹⁶ The units designated by participating sources were then entitled to receive allowances based on the same historical baseline as the sources originally included in the program. About 75% of firms took advantage of these provisions, increasing the number of units involved in Phase I by roughly 50%.²¹⁷ The use of this provision led to an adverse selection problem that inflated the initial caps as sources designated substitution units that would have decreased their emissions anyway.²¹⁸

A ratchet is a mechanism for holding the line on the overall program cap in the face of a complex and contested allocation process. As explained by the EPA, a ratchet is a formula that adjusts each source's allocation proportionately such that the total allocation will match the number of allowances in the predetermined cap.²¹⁹ In the ARP, the law's ratchet provision came

212. *Id.*

213. OVER A DOZEN YEARS OF RECLAIM, *supra* note 33, at I-4-2.

214. Harrison, *supra* note 33, at 49. Harrison served as a consultant to SCAQMD regarding RECLAIM. *Id.* at 45.

215. *Id.* at 49.

216. *See* Markets for Clean Air, *supra* note 10, at Chapter 8 (on "voluntary compliance programs"); Tietenberg, *supra* note 197, at 82.

217. Swift, *supra* note 1, at 340; MARKETS FOR CLEAN AIR, *supra* note 10, at 197.

218. MARKETS FOR CLEAN AIR, *supra* note 10, at 197-220; Swift, Environmental Laws, *supra* note 1, at 340.

219. TOOLS OF THE TRADE, *supra* note 25, at 3-16.

into effect after the allocations to individual sources were determined because the sum of these allocations exceeded the level of the legislatively determined Phase II cap of 8.9 million tons.²²⁰ As applied, the ARP ratchet reduced every source's basic allocation in Phase II by about 10%.²²¹ While observers of the allocation process had expected that the ratchet would need to be applied to meet the legislative limit, they underestimated the size of the ratchet by about half.²²² If the law had established a ratchet for Phase I as it did for Phase II, the ARP's early overallocation might have been avoided.

A ratchet provision is thus an important backstop to ensure that the allowance distribution decisions made during the allocation process do not compromise the stringency of the overall program caps. More specifically, the ratchet should be designed to ensure that those overall program caps achieve the emissions reductions that are consistent with the feasibility principle. In the case of a program like RECLAIM in which caps progressively decline to meet an emissions reduction level that is based on feasibility, a ratchet could also be applied to the initial allocation to ensure that it is not above BAU emissions.

C. Adjusting Caps

In existing cap-and-trade programs, a central design tenet has been to establish cap levels for the lifetime of the program. The establishment of caps in advance provides participants with a consistent and predictable environment for compliance decisions.²²³ Caps that are fixed over the long term also provide the environmental certainty that attracts environmentalists to cap-and-trade programs. However, such caps are inflexible and unresponsive in the face of possible changes to available information about environmental problems, economic conditions, technological development and program performance. Such rigidity can easily become a problem for a program's

220. *MARKETS FOR CLEAN AIR*, *supra* note 10, at 37 n.10.

221. *Id.*

222. *Id.* at 37 n.10 (noting that the large size of the ratchet surprised many who thought it would be less than 5%).

223. *Cf. TOOLS OF THE TRADE*, *supra* note 25, at 3-2. *See also* Stavins, *supra* note 6, at 299 (stating that "[b]alancing credibility of long-run targets and flexibility is an important issue for the success" of a cap-and-trade program.).

environmental effectiveness. Even caps set based on feasibility at the outset of programs may still turn out to be inadequately stringent because of the inherent unpredictability of technological, economic, and regulatory factors that affect allowance demand. To maintain stringency, there should be mechanisms available to tighten caps. This section first explains why cap adjustment is needed and then discusses potential cap adjustment mechanisms.

1. Why Caps Should be Adjustable

As suggested above, caps in cap-and-trade programs should be at least as stringent as necessary to match the emissions reduction levels that would be achieved by applying the feasibility principle. While efforts should be made to ensure that initial caps reduce emissions to the levels that would be achieved by applying the feasibility principle, such efforts may be inadequate. Regulators may incorrectly analyze feasibility such that initial caps might not in fact be adequately designed to achieve feasible emissions reductions, or there may be technological development or other changes that alter the feasibility analysis.

In cap-and-trade programs that set forth inflexible caps, regulated sources will lobby to ensure that the costs of the program are acceptable to them regardless of the outcome of many uncertainties that could affect the demand for allowances.²²⁴ Their industries might grow or decline; weather conditions might increase or decrease energy demand; or new technologies may or may not be developed that lower the cost of pollution control. Regulated sources will tend to argue for caps that ensure that the costs associated with meeting the caps are acceptable even in the highest allowance demand scenario. But if this demand scenario does not materialize, the program might end up being overallocated with respect to feasibility or even BAU and become less environmentally effective.

The experience from existing programs illustrates how program designers may be unable to predict demand with reasonable

224. As explained by Kenneth C. Johnson, there is a conflict between cost-acceptability and environmental effectiveness. See Letter from Kenneth C. Johnson to John D. Dingell, U.S. Representative (March 16, 2007) *available at* http://kjinnovation.com/Dingell_2007_03_16.pdf; See also Letter from Kenneth C. Johnson to the Climate Action Team, Cap and Trade Subgroup (Jan. 30, 2006) *available at* http://www.climatechange.ca.gov/publications/cat/comments/KenJohnsonComments_01-30-06.pdf.

accuracy. In both RECLAIM and ERMS, the contraction of participating industries led to plant shutdowns that in turn contributed to overallocation.²²⁵ By 1999, almost 15% of RECLAIM facilities had shut down.²²⁶ As noted by SCAQMD, “low-cost [allowances] have been readily available as a result of a number of equipment and facility shutdowns.”²²⁷ In ERMS, by 2005, 36 facilities with no emissions continued to receive allocations, but only nine new facilities had entered the program. Shutdowns thus led to excess allocations equal to 14% of the total allocation.²²⁸

In ERMS, a significant part of the overallocation in the program resulted from the fact that sources reduced their emissions to comply with coexisting conventional environmental regulations. These included regulations promulgated by the state of Illinois for ozone compliance, state and federal regulations pertaining to Hazardous Air Pollutants, New Source Review regulations affecting new and modified facilities, and existing and anticipated federal regulations affecting the VOM content of consumer products and coatings.²²⁹ A recent study of the causes of overallocation in ERMS concluded that about one-third of the reduction in the number of allowances that sources needed to comply with ERMS was due to the impact of other regulations.²³⁰

The early overallocation in the ARP finds some explanation in the fact that legislators did not adequately account for the shift from high-sulfur to low-sulfur coal that was occurring

225. RECLAIM and ERMS, like most other cap-and-trade programs, allowed for the continued allocation of allowances to closed facilities based on the economic justification that it provides the “correct incentives” for economically efficient behavior. THE TEN-YEAR RULE, *supra* note 64, at 7–8 (explaining that a program that withdraws allowances upon facility closure “turns the allocation into a subsidy to production, because the firm earns the allocation *if and only if* it continues to operate the installation.”) (emphasis added). Unlike other programs, Phase 1 of the EU ETS provided that allowance allocations would cease upon facility closure. See Ellerman & Buchner, *supra* note 59, at 75. For a full discussion, see THE TEN-YEAR RULE, *supra* note 64, at 11–12.

226. SCAQMD, ANNUAL RECLAIM AUDIT REPORT FOR THE 2000 COMPLIANCE YEAR, at G-8 (2002).

227. SCAQMD, REVIEW OF RECLAIM FINDINGS 1-30 (2000).

228. Evans & Kruger, *supra* note 48, at 21; see also *id.* at 27 (addressing shutdowns and industry contraction).

229. *Id.* at 26.

230. *Id.* at 27 (the other significant causes of overallocation included inflation in the baseline-setting process and industry contraction). See also Kosobud et al., *supra* note 48, at 10 (concluding that the coexistence of ERMS with such other regulations was the primary cause of low allowance prices and expiring allowances).

independently of the program.²³¹ When the ARP was enacted in 1990, Congress expected SO₂ emissions to rise as power plants used more coal to produce more energy and set the caps accordingly.²³² Instead, between 1990 and 1993, SO₂ emissions at all power plants declined by 5% and SO₂ emissions at Table A units declined by almost 13%, “mostly for reasons unrelated” to the Program.²³³ Most significantly, the economics of coal choice changed such that low-sulfur coal became less expensive than high-sulfur coal for many power plants. There was also a “surprising degree of innovation in blending [of high and low-sulfur coal] and the adaptation of existing plants [to low-sulfur coal].”²³⁴ As such, the forecasts that SO₂ emissions would rise after 1990 in the absence of Title IV were incorrect.²³⁵

Studies of the ARP suggest that the program has left many socially-valuable emissions reductions on the table. In Phase I, allowance prices were far below the estimates of the social benefits of additional SO₂ reductions, which were calculated to be more than \$5000 per ton.²³⁶ Moreover, environmental data available as early as the late 1990s indicated that more stringent limits on the emissions of SO₂ and NO_x would be necessary to fully address the acid rain problem.²³⁷ A 2005 study of the costs and benefits of the program estimated the annual benefits of the program, as fully implemented in 2010, at \$122 billion and its costs for that year to

231. Don Munton, *Dispelling the Myths of the Acid Rain Story*, ENV'T, July–Aug. 1998, at 4, 28–29 (explaining that cost estimates used by Congress failed to take into account the low costs of switching to low-sulfur coal and the extent to which fuel-switching was already occurring).

232. Ellerman & Montero, *supra* note 87, at 27.

233. *Id.* at 27, 29 tbl.I (using given data to calculate percentage declines). Ellerman and Montero specifically remark that the largest reductions in emissions occurred at Table A not because of their inclusion in Phase I of the ARP but because of the economics and geography of low-sulfur coal. *Id.* at 43.

234. *Id.*

235. *Id.* at 42.

236. Swift, *supra* note 1, at 377–79 (asserting that Phase I caps were too lenient based on the fact that allowance prices were lower than the marginal social benefit).

237. See e.g., C. T. Driscoll et al., *Acid Rain Revisited: Advances in Scientific Understanding Since the Passage of the 1970 and 1990 Clean Air Act Amendments*, SCI. LINKS PUBL'N, 2001, available at <http://www.hbrook.sr.unh.edu/hbfound/report.pdf>; CLEAN AIR TASK FORCE, *Unfinished Business: Why the Acid Rain Problem is not Solved*, October 2001, available at http://www.catf.us/publications/reports/Acid_Rain_Report.pdf (asserting that the ARP's emission cap is about a factor of five higher than the level required for environmental sustainability); see also Hsu, *supra* note 134, at 448–49 n.111.

be 40 times lower at \$3 billion.²³⁸ As the authors of the cost-benefit study state, “the greater than expected benefits to human health, the greater vulnerability of natural resources and ecosystems, and the lower than expected costs all point to the conclusion” that further emissions reductions from power plants, beyond those that the ARP currently requires, are warranted.²³⁹

The emissions reductions that EPA envisioned under CAIR provide an indication of the large gap between the current ARP caps and more stringent caps that are currently technologically and economically feasible. EPA projected that in 2010 and 2015 CAIR would have reduced SO₂ emissions affected by the rule to 45% and 57%, respectively, of their 2003 levels.²⁴⁰ At full implementation between 2015 and 2020, CAIR would have reduced power plant SO₂ emissions to 2.5 million tons, 73% below 2003 emissions levels. It can be presumed that the emissions reductions projected by the EPA were technologically and economically feasible.

In programs where caps are less stringent than they were expected to be, the costs of meeting the cap will be lower than anticipated. Yet if program designers had realized that the costs of meeting the cap would be as low as they were, they may well have chosen to impose a more stringent cap. Sources would have been able to meet a more stringent cap for the same cost, which was presumably an acceptable cost to industry. In programs where regulators set inflexible caps for many years, the caps will not be capable of responding to new information about the technological and economic feasibility of pollution abatement.

3. Mechanisms to Adjust Caps

There are a variety of ways in which cap-and-trade programs could be designed to allow for adjustment in the caps. Mechanisms

238. Chestnut & Mills, *supra* note 7, at 265 (The benefits were higher than in past analyses primarily because of recognition of greater health benefits from the SO₂ reductions. The costs of the program were lower than half the expected cost in 1990 because of the lower-than-expected costs of using low-sulfur coal and cheaper-than-expected installation and operation of scrubbers). For additional evidence of a mismatch between costs and benefits, see Israel, *supra* note 92, at 373, 383 (Interpreting the amount bid in SO₂ allowance auctions by environmental groups as the marginal benefit from one additional ton of emissions reductions, and finding that it significantly exceeds the marginal abatement cost as reflected in the market price of allowances).

239. Chestnut & Mills, *supra* note 7, at 265.

240. EPA, Clean Air Interstate Rule, Basic Information, <http://epa.gov/interstateairquality/basic.html> (last visited Mar. 26, 2009).

to adjust caps could be automatic in the sense that they “respond immediately to market conditions and adjust the level of allowable emissions as opposed to the regulator revisiting the program.”²⁴¹

One mechanism that could work automatically is setting an allowance price floor. If the price of allowances fell to the floor, the regulator would be required to take some predetermined action to reduce the oversupply of allowances in the market.²⁴² This action might consist of confiscating allowances, buying them back, or reducing the number of allowances allocated in the next compliance period. The allowance price floor could be periodically adjusted under the discretion of the regulatory agency.²⁴³

Alternatively, cap-and-trade programs could grant the responsible regulatory agency discretionary power to directly adjust caps.²⁴⁴ In RECLAIM, for example, California state law required that SCAQMD periodically review the program to evaluate whether additional reductions were warranted to “reflect the current level of technology available” for participating sources.²⁴⁵ In 2005 SCAQMD undertook the first such review and amended the RECLAIM rules to reduce the program cap by 20% by 2011.²⁴⁶ SCAQMD suggests that “such periodic assessments would be

241. Evans & Kruger, *supra* note 48, at 30.

242. *Id.* In contrast, a “safety valve” mechanism addresses the problem of higher-than-anticipated allowance prices by allowing regulated facilities to purchase additional allowances at a set price. *Id.* Some have called the idea of setting both an allowance price ceiling and allowance price floor a “symmetric safety valve.” Dallas Burtaw et al., *Chapter 5: Lessons for a Cap-and-Trade Program*, in *MANAGING GREENHOUSE GAS EMISSIONS IN CALIFORNIA* 5-17, 5-19, available at http://calclimate.berkeley.edu/5_Cap_and_Trade.pdf.

243. *Full Committee Oversight Hearing: To receive testimony on Energy and Related Economic Effects of Global Climate Change Legislation*, 110th Cong. (2008) (statement of Peter R. Orszag, Dir., Cong. Budget Office).

244. An important precondition to enabling cap adjustments for stringency is that cap-and-trade programs deny allowances the status of private property. *Cf.* Tietenberg, *supra* note 197, at 79; *OVER A DOZEN YEARS OF RECLAIM*, *supra* note 33, at I-3-2, I-3-11. The Clean Air Act Amendments that created the ARP explicitly denied the property status of allowances: “an allowance allocated under this subchapter is a limited authorization to emit sulfur dioxide in accordance with the provisions of this subchapter. Such allowance does not constitute a property right.” Clean Air Act, 42 U.S.C. § 7651b(f) (2000). RECLAIM rules also explicitly disclaim any intent to create a property rights, stating that an allowance “shall not constitute a security or any form of property.” RECLAIM Rule 2007, reviewed by *OVER A DOZEN YEARS OF RECLAIM*, *supra* note 33, at I-3-12, III-1-5. RECLAIM rules further reserve to the implementing agency the right to “condition, limit, suspend, or terminate” allowances. Rule 2015(b)(5), available at <http://www.aqmd.gov/rules/reg/reg20/r2015.pdf>.

245. *OVER A DOZEN YEARS OF RECLAIM*, *supra* note 33, at I-2-5, III-1-2.

246. *Id.* at I-2-5.

valuable for future cap-and-trade programs.”²⁴⁷

The experience of the ARP illustrates the danger of leaving cap adjustments in the hands of a legislature. The environmental effectiveness of the program could have been enhanced if the EPA had been granted authority under Title IV to downwardly adjust the annual caps based on program performance and environmental data. Rather, the statute required congressional action to adjust the number of allowances issued. Congressional efforts to lower the cap were unsuccessful.²⁴⁸ Ultimately, the EPA tried to get around this statutory constraint by changing the denominations for SO₂ allowances issued after 2010 and 2015 as part of the CAIR.²⁴⁹ Under CAIR, allowances issued to sources after 2010 would have had a value of 0.5 tons SO₂ in the years of 2010 through 2014 and 0.35 tons SO₂ after 2015.²⁵⁰ These changes to the value of allowances would have effectively reduced the cap by one-half in 2010 and by another third in 2015.²⁵¹ In July 2008, the D.C. Circuit vacated CAIR in part because of its inconsistency with the allowance allocation system contained in Title IV.²⁵²

A well-designed auction could eliminate many of the opportunities for sources to influence allocations in ways that inflate caps and could provide a means of adjusting annual caps. Although scholars often discuss the auctioning or sale of allowances in the literature on cap-and-trade, almost all existing programs provide for the free distribution of allowances.²⁵³ Auctioning

247. *Id.* at III-1-2.

248. Hsu, *supra* note 134, at 448–49 n.111. See also D. R. Wooley & E. M. Morss, *The Clean Air Act Amendments of 1990: Opportunities for Promoting Renewable Energy*, Dec. 2001, at 10, available at <http://www.nrel.gov/docs/fy01osti/29654.pdf>.

249. MAC REPORT, *supra* note 1, at 17. Emission allowances issued in earlier years retain their original value in terms of tons per allowance. *Id.*

250. Clean Air Interstate Rule, 70 Fed. Reg. 25,162, 25,274 (May 12, 2005) (stating that “Sulfur dioxide reductions are achieved by requiring sources to retire more than one allowance for each ton of SO₂ emissions. The emission value of an SO₂ allowance is independent of the year in which it is used, but is based upon its vintage (i.e., the year in which the allowance is issued). Sulfur dioxide allowances of vintage 2009 and earlier offset one ton of SO₂ emissions. Vintages 2010 through 2014 offset 0.5 tons of emissions. And, vintages 2015 and beyond offset 0.35 tons of emissions.”) These reduced allowance values only apply to sources that are required under CAIR to reduce SO₂ emissions, consisting of 23 eastern and Midwestern states and the District of Columbia. *Id.* at 25,167.

251. Ellerman & Joskow, *supra* note 59, at 41.

252. *North Carolina v. EPA*, 531 F.3d 896, 921–22 (D.C. Cir. 2008).

253. See Bruce A. Ackerman & Richard B. Stewart, *Reforming Environmental Law: The Democratic Case for Market Incentives*, 13 COLUM. J. ENVTL. L. 171, 189 (1988); Ellerman & Buchner, *supra* note 59, at 85–86. Scholars have often asserted that the allocation method—

allowances would eliminate many opportunities for sources to influence the allocation process in ways that contribute to overallocation. Moreover, an allowance price floor could also be implemented by establishing a minimum bid price and, if the clearing price in the auction were too low, reducing the number of allowances being auctioned.²⁵⁴ According to one commentator, if the ARP had established an allowance auction with a price floor set at \$300, the lower end of most cost estimates in 1990, “far less SO₂ would have been released during Phase I.”²⁵⁵ Moreover, far fewer allowances would have been banked, and less SO₂ would have been released during Phase II.

An Australian proposal for a national cap-and-trade system to reduce greenhouse emissions sets forth an approach to cap adjustment that may be capable of providing sufficient certainty about cap levels for industry without unduly compromising the government’s ability to respond to unforeseen changes.²⁵⁶ The proposal suggests that the government set firm emissions caps for a five-year period.²⁵⁷ As the program moves forward, the government would set a firm cap for the subsequent year such that regulated entities would always know the size of the cap for the next five years. The proposal also suggests that the government supplement the firm caps with “indicative caps” that set the likely range of the firm caps out to 2050.²⁵⁸

Climate change bills that would implement a major cap-and-trade program to regulate carbon emissions in the United States have envisioned the creation of a new institution that might have powers to amend program caps. The Lieberman-Warner Climate Security Act would have created a “Carbon Market Efficiency Board” to

whether by free distribution or by auction—is environmentally neutral, but this assumes that the overall program cap is the same whether allowances are distributed free of charge or auctioned. See, e.g., TOOLS OF THE TRADE, *supra* note 25, at 3–14; *Pew Center on Global Climate Change, Response to “Design Elements of a Mandatory Market-Based Greenhouse Gas Regulatory System,” Issued by Sen. Pete V. Domenici and Sen. Jeff Bingaman*, Feb. 2006, http://www.pewclimate.org/policy_center/analyses/sec/q2.cfm (last visited, March 26, 2009).

254. Evans & Kruger, *supra* note 48, at 30.

255. Swift, *supra* note 1, at 380 n.348.

256. Lesley K. McAllister, *Australia Should Adopt Trading Scheme with Full Auctioning of Permits, Advisor Says*, 31 INT’L ENV’T REPORTER 667 (2008).

257. *Id.*

258. *Id.* See also Australian Government, Department of Climate Change, Scheme Caps and Gateways: Fact Sheet 6 (July 2008), available at <http://www.climatechange.gov.au/greenpaper/factsheets/fs6.html> (last visited, March 31, 2009).

monitor the carbon market and make necessary adjustments.²⁵⁹ However, this entity would have apparently been oriented towards ensuring cost-acceptability, as it was empowered to make caps less stringent in response to increases in allowance prices. To promote environmental effectiveness, such an entity should also have the power to make program caps more stringent.

CONCLUSION

While conventional environmental law was plagued by goals that were too ambitious, a problem in cap-and-trade so far has been goals that are not ambitious enough. Some programs have suffered from absolute overallocation, in which caps are set above BAU emissions and the program produces few, if any emissions reductions. Others have experienced early overallocation, which while not always fatal, also compromises a program's environmental effectiveness. The common effects of overallocation include low allowance prices, delayed emissions reductions, and the establishment of a large allowance bank that allows for greater future emissions.

Recently-developed cap-and-trade programs that regulate greenhouse gas emissions are also experiencing problems with overallocation. The Regional Greenhouse Gas Initiative (RGGI) has been estimated to be overallocated by 17% in its first year of operation: the power plants in the RGGI states that are subject to the program generated about 155 million tons of carbon dioxide in 2008, and the 2009 cap is set at 188 million tons.²⁶⁰ It is also now projected that there will be a surplus of allowances allocated in Phase 2 of the EU ETS, which covers the years 2008 through 2012.²⁶¹ The allowance price fell from a high of \$30 in July 2008 to below \$15 in December 2008, and some analysts predict continued negative price pressure.²⁶²

259. The Lieberman-Warner Climate Security Act, S. 2191, 110th Cong. (2007) (as reported by S. Comm. on the Environment and Public Works, December 5, 2007). A summary of the core of the bill is available at <http://lieberman.senate.gov/documents/detailedacsa.pdf> (last accessed Mar. 9, 2009).

260. Point Carbon Research, Carbon Market Brief North America, March 16, 2009.

261. Commodities Now, "Barcap says EU ETS long in Phase II EU ETS," London, April 15, 2009, available at <http://www.commodities-now.com/content/market-news/market-news-2009041532723.php?PHPSESSID=d4800263ce3297f58c893ea962aba019> (last visited April 30, 2009).

262. Michael Szabo, "EU CO2 To Drop 10 pct Below 2007 Levels: Deutsche," Planet

This article argues that program caps should be established based upon agency determinations about the feasibility of emissions reductions. More specifically, caps should be set at levels that ensure that the programs achieve technologically and economically feasible emissions reductions. Given the prevalence of overallocation and its impact on environmental effectiveness, mechanisms need to be incorporated into cap-and-trade programs that are capable of reining in overallocation, both before cap-and-trade programs commence and after they are underway. The Article suggests the use of a ratchet to counteract cap inflation that occurs during the allocation process, and it advocates the incorporation of automatic and discretionary mechanisms such as allowance price floors and auctions to adjust caps during program implementation.

While requiring less of regulated sources is more politically appealing, it may well not be sufficiently protective of the environment. A cap-and-trade program with high caps may make it look like something is being done when very little actual improvement can be attributed to the program. In other words, part of the story of why cap-and-trade programs may appear to be so cost effective may simply be that to do less costs less. In the case of RECLAIM, a Los Angeles Times article may have hit the mark when it stated that “Companies saved an estimated 41% on compliance costs under RECLAIM compared to conventional regulation, although most of the savings occurred because pollution controls were delayed for too long.”²⁶³

This article makes clear that one of the key dilemmas in environmental law and policy—how to balance economic and environmental goals—does not disappear when cap-and-trade is chosen as the regulatory instrument. The decision to employ a cap-and-trade program does not ensure the attainment of the optimal level of pollution. Rather, where the cap is not stringent, a suboptimal level of pollution may become locked in for a substantial period of time. Overallocation is a problem for program success and, in the design of future programs, designers should

Ark, December 8, 2008, available at <http://www.planetark.com/enviro-news/item/50817> (last visited April 30, 2009).

263. See Gary Polakovic, *Innovative Smog Plan Makes Little Progress; Air Quality: After Eight Years, the Southland's Program Allowing Firms to Trade Pollution Credits has Fallen Well Below Expectations. Ideas to Fix it are Mired in Controversy*, L.A. TIMES, Apr. 17, 2001, at B1.

take precautions to avoid it. The environmental effectiveness of cap-and-trade regulation will really only be proven when programs create truly constrained allowance markets that force the maximally feasible emissions reductions that our environmental laws have so often required.