Wasting Away: Why Federal Environmental Statutes Are Currently Unable to Regulate Radio Frequency Identification Chip Disposal and Prevent Widespread Environmental Harm

By B Jennifer Lemieux

B Jennifer Lemieux is a J.D. Candidate, Roger Williams University, 2009. She would like to thank Prof. Jared Goldstein for his helpful comments and suggestions on the many drafts of this Article, and Prof. Anne Lawton, Megan K. Maciasz, and Timothy Mahoney for their assistance with editing comments and suggestions.

Imagine a world in which retailers and manufacturers know where every consumer item is at all times. From manufacture to the point of sale, every consumer item can be tracked individually along the supply chain. Out-of-stocks are virtually eliminated. Imagine finding *every* item on your list, *every* time you go into a store—any store. Would you spend less? According to the retail industry you would.[1] Retailers claim that radio frequency identification (RFID) technology will transform the way business is done and the shopping experience itself by reducing out-of-stock merchandise and tracking inventory throughout the supply chain.[2] Accordingly, shoppers will pay less for items, because the cost of doing business will be less.

RFID technology allows retailers to track manufacturers' items from a distribution center, through transit, and on to individual stores. Once at the store, RFID tells managers how many items are in stock and exactly where those items are, right down to the particular shelf the item is sitting on.[3] To that end, retailers are promoting "item-level tagging," where every item's packaging is affixed with an RFID tag.[4]

In American consumer society, item-level tagging could result in tens of billions of tags used annually in the retail industry alone.[5] American consumers are used to instantaneous gratification. Consumers want it now and want it cheap. Unwanted goods, along with their packaging, are placed curbside on the designated day and magically disappear. In 2005, Americans sent approximately 4.5 pounds (lbs.) of waste per person, per day, to landfills.[6] In the future, that waste will include packaging and used goods containing RFID tags. Alone, each chip, which can be the size of a grain of sand, poses no undue risk. But tens of billions of these chips, each containing heavy metals and small amounts of hazardous elements such as arsenic and germanium, will end up in America's landfills, left to slowly leach out their hazardous components.[7]

The best way to ensure that the toxic constituents in RFID chips do not make their way into our nation's soils, groundwater, or surface water is to regulate RFID chip disposal to prevent harm to human health and the environment. Possible regulating authorities include federal, state, and local agencies. Currently, no federal agency has chosen to regulate

1. Mark Robert, *RFID's Consumer Benefits*, RFID J., http://www.rfidjournal.com/article/articleprint/398/-1/2/ (last visited Jan. 28, 2009).
2. Laura Hildner, *Defusing the Threat of RFID: Protecting Consumer Privacy Through Technology-Specific Legislation at the State Level*, 41 Harv. C.R.-C.L. L. Rev. 133, 135 (2006).
3. Jerry Brito, *Relax Don't Do It: Why RFID Privacy Concerns Are Exaggerated and Legislation Is Premature*, 5 UCLA J.L. Tech. 4 (2004).
4. *Id.*; *see also* Lars S. Smith, *Symposium Review: RFID and Other Embedded Technologies: Who Owns the Data?*, 22 Santa Clara Computer & High Tech. L.J. 695, 696 (2006) (the smaller sizes of RFID tags make item-level tagging possible in the future).
5. Rob Glidden, *RFID: The Next Big Little Thing*, http://www.fcc.gov/realaudio/presentations/2004/100704/RobGlidden.pdf (last visited Jan. 28, 2009); *see also* Smith, *supra* note 4, at 755 n.18; Gilbert, *infra* note 50 (the second-largest RFID application—behind retail use—will be in the postal industry with potentially one trillion postal items tagged yearly by 2020).
6. U.S. Environmental Protection Agency (EPA), *Basic Facts: Municipal Solid Waste (MSW)*, http://www.epa.gov/garbage/facts.htm (last visited on Jan. 28, 2009).
7. Marshall Brian, *How Semiconductors Work*, How Stuff Works, http://computer.howstuffworks.com/diode.htm/printable (last visited Jan. 28, 2009); *see also* U.S. Government Accountability Office, Report to Congressional Requesters, Information Security: Radio Frequency Identification Technology in the Federal Government 26 (2005) (GAO-05-551) [hereinafter GAO-05-551] (tags contain silicon, adhesives, and nickel and the antennae are typically made from copper, aluminum or silver); *Semiconductor Materials*, San José State University, http://www.engr.sjsu.edu/WofMatE/Semiconductors.htm (last visited Feb. 19, 2009) (there are three semiconducting elements: (1) Silicon (Si); (2) Germanium (Ge); and (3) Tin (Sn), with Si and Ge the most widely used. Another important material is GaAs, a compound of Gallium (Ga) and Arsenic (As)).

RFID technology.[8] Absent specific federal RFID regulation, existing federal environmental statutes are inadequate to regulate RFID chip disposal. Federal environmental statutes either contain loopholes that exempt the chips from regulation or regulation is retrospective, applying after contamination occurs. Some states have proposed legislation regarding RFID use, but no state has proposed legislation regulating RFID chip disposal. Existing municipal regulations govern bottle, can, and paper recycling, typically by encouraging or mandating participation, and electronic waste (e-waste), typically by charging a fee for household disposal. To regulate RFID locally, municipalities would need to recognize RFID chips as e-waste and charge residents for proper disposal, but RFID chips are not currently classified as e-waste. Municipal regulation will be ineffective for two reasons. First, recycling mandates place an unfair financial burden on the consumer. Second, making sure that consumers are not avoiding the disposal fee by throwing the chips out with their regular trash is impractical, if not impossible, given the chips' small size. Forcing retailers to be responsible for proper RFID chip disposal through federal regulation is the most efficient option to prevent widespread harm to human health and the environment. Rather than create a new federal statute to regulate RFID chip disposal, the U.S. Environmental Protection Agency (EPA) should specifically list RFID chips as a hazardous waste so that proper disposal would be mandatory under the federal Resource Conservation and Recovery Act (RCRA).[9]

This Article first explains what RFID is, including the technology, its components, potential hazards, and what companies or organizations are using RFID technology and how. Second, it points out the potential environmental impact of tens of billions of chips making their way through America's waste stream. Next, it discusses existing federal, state, and local regulations and explains why each of these regulations, as currently written, is inadequate to control RFID chip disposal. Finally, this Article concludes that the best regulatory solution to avoid widespread environmental harm resulting from RFID chip disposal is to specifically list RFID chips as hazardous waste under RCRA so that proper disposal will be mandatory.

I. What Is RFID?

A. The Technology

RFID has been around since the cold war. In the 1970s and 1980s, advances were made resulting in applications to a wider range of products.[10] RFID systems store and transmit data and are most commonly used for identification data.[11] The basic components of an RFID system are the tag and the reader.

The tag consists of a small antenna that is attached to an even smaller chip and printed on a sticker to allow it to be attached to items.[12] Readers are stationary hardware that scan a particular frequency for tag signals.[13] Tags "listen" for signals sent by readers and transmit their own particular electronic product code (EPC) to a reader upon sensing a signal.[14] RFID systems are uniquely suited to tracking merchandise along the supply chain because the small chip size means tags can be affixed to virtually any product and its hardware configuration requires few expensive readers, instead relying on more of the relatively inexpensive tags.

Each tag is identified by an individual code, an EPC, similar to a universal product code (UPC), but far superior.[15] Scanning a UPC on a microwave tells the scanner that it is a microwave. Retailers find this helpful because that scanned UPC can tell them how many microwaves are in stock, in transit, and on order. An EPC on a microwave tells the retailer whether a particular microwave is in stock and exactly where it is at any given moment while in the supply chain.[16] Thus, EPCs not only identify *what* a product is, but exactly *which* product it is among a warehouse full of the same item.

There are two types of tags: (1) active; and (2) passive. Active tags contain a battery source and as a result are larger, can be read from farther away, and are more expensive.[17] The more common type of tag is a passive tag. Passive tags are small because they do not have a battery and are instead activated by a nearby reader.[18] Readers can find passive tags at distances up to about 30 feet away.[19] Passive tags are deceptively durable for such tiny objects. The tags can survive a run through a clothes washer and dryer and close contact with powerful magnets.[20] As the technology evolves, passive tags are getting smaller and cheaper, setting the stage for widespread item-level tagging by retailers in the near future.[21]

8. *The Future Is Here: A Beginner's Guide to RFID*, RFID Gaz., http://www.rfidgazette.org/2004/06/rfid_101.html (last visited on Jan. 28, 2009) [hereinafter *RFID 101*].
9. 42 U.S.C. §§6901-6992k, ELR Stat. RCRA §§1001-11011.
10. *The History of RFID Technology*, RFID J., http://www.rfidjournal.com/article/view/1338/1/129 (last visited Jan. 29, 2009).
11. Smith, *supra* note 4, at 700.
12. Dave Williams, RFID—Hot Technology With Wide-Ranging Applications, Directions Mag., http://www.directionsmag.com/article.php?article_id=526&trv=1 (last visited Jan. 28, 2009); *see also* GAO-05-551, *supra* note 7, at 5 (tags consist of a chip and an antenna). Fans of National Football League (NFL) football may notice colored stickers on the back of quarterback's helmets. Likely these are antennas that enable play coaches to radio in the play signals.
13. Darren Handler, *Article: The Wild, Wild West: A Privacy Showdown on the Radio Frequency Identification (RFID) Systems Technological Frontier*, 32 W. St. U. L. Rev. 199, 203 (2005).
14. Brito *supra* note 3, at 2.
15. Handler *supra* note 13, at 203.
16. Smith, *supra* note 4, at 700-01; *see, e.g.*, Hildner, *supra* note 2, at 134.
17. Smith, *supra* note 4, at 702; *see also* Brito, *supra* note 3, at 3.
18. Brito, *supra* note 3, at 3.
19. Handler, *supra* note 13, at 204.
20. *Id.*
21. *Id.* at 205 (tag orders in ten billion quantity lots could drive the price of tags down to just $.05 per tag).

Tags are useless, however, without readers. Readers collect transmitted data from nearby tags and send it via cable or wireless networks to a company's computer system that is enabled with identification or tracking software.[22] Readers can be portable or fixed at convenient locations such as dock doors, stockroom doors, or checkout areas.[23] Readers can also be surreptitiously placed in floor tile, carpet, or benches.[24] Entire truckloads of merchandise can be scanned in one fell swoop by readers, eliminating the need to scan every item as it is loaded or unloaded and allowing for greater accountability and increased speed in the loading, unloading, and delivery processes.[25] In fact, high-quality tags can be read from any angle and at speeds of up to 1,200 feet per second, enabling companies to increase conveyor belt speeds and productivity without sacrificing accuracy.[26] With such obvious benefits, it is easy to see that RFID potentially could have an enormous impact on the retail supply chain as tag costs continue to come down and companies embrace the technology.

RFID tags may seem innocuous because they look like a sticker, but every tag is a potential contaminant.[27] Tag antennae are typically made of copper, aluminum, or silver.[28] Each tag also contains a semiconductor chip. Most semiconductor chips are made with silicon.[29] Pure silicon is an insulator that allows very little electricity to flow through it.[30] However, "doping" silicon, or adding small amounts of impurities into the silicon crystal, turns a good insulator into a fair electrical conductor—hence the name semiconductor.[31] There are two types of impurities in the doping process: (1) N-type; and (2) P-type.[32] N-type adds small amounts of phosphorus or arsenic to the silicon, while P-type adds small amounts of boron or gallium.[33] Adding either type creates a semiconductor, but a simple one, not the complex semiconductor chip found in an RFID tag.[34] Think of each type as a layer. A silicon semiconductor chip contains many layers, each layer containing a small amount of an impure element.[35] Thus, RFID tags containing silicon semiconductor chips, which can be as small as a grain of sand, each contain small amounts of toxic impurities.[36]

B. The Applications

RFID has nearly endless applications and the number of industries considering implementing it may surprise the average consumer. For instance, familiar items like the ExxonMobil Speedpass or EZ-Pass toll collection transponders use RFID.[37] RFID can be implanted in animals to help find lost pets, and the U.S. Department of Agriculture wants to implant RFID chips in every cow in the country to make it easier to track diseases to the originating location.[38] In fact, Michigan has already passed legislation that mandates this.[39] Human implantation is also possible, either to keep track of incarcerated individuals, the mentally disabled, children, or to provide hospitals with instant access to a person's medical history.[40] By linking a driver's license and credit card to a human implanted chip, you could enter a club with a wave of the wrist and pay for your drinks as well.[41] In Germany, RFID chips were embedded in FIFA World Cup citizen tickets and purchasers were required to provide personal information that was entered into a database and shared with security agencies, stadium operators, and shipping providers.[42] The U.S. Department of Defense (DOD) is using RFID to track shipments and the U.S. Department of Homeland Security is using it to follow assets, weapons, and baggage on flights.[43] Commercial airlines are also interested in using RFID to track passengers' baggage.[44] The U.S. Department of State, along with the European Commission and countries such as Japan, require RFID chips embedded in all new passports.[45] China requires RFID chips in resident identification cards and an estimated one billion cards were issued in 2008, with 2.9 billion more to be issued in 2009.[46] Pharmaceutical companies are interested in RFID to combat prescription drug counterfeiting.[47] Some countries are considering putting chips in money, and the United States is investigating placing chips in stamps to

22. Brito, *supra* note 3, at 3; *see also* Smith, *supra* note 4, at 700.
23. Brito, *supra* note 3, at 3; *see also* GAO-05-551, *supra* note 7, at 9 (readers can be mobile, such as handheld devices that scan objects like pallets, cases, or goods, or stationary, such as point-of-sale devices placed at checkouts).
24. Handler, *supra* note 13, at 204.
25. *RFID 101*, *supra* note 8; *see also* John M. Eden, *When Big Brother Privatizes: Commercial Surveillance, the Privacy Act of 1974, and the Future of RFID*, 2005 Duke L. & Tech. Rev. 20, 30 (tags can be read simultaneously); Hildner, *supra* note 2, at 134 (readers can process multiple items at once).
26. Eden, *supra* note 25, at 3-4.
27. GAO-05-551, *supra* note 7, at 26.
28. *Id.*
29. Brian, *supra* note 7.
30. *Id.*
31. *Id.*
32. *Id.*
33. *Id.*
34. Layering an N-type and a P-type together creates a diode in which electrical current cannot flow between the two layers. Devices that use batteries typically contain a diode to prevent damage to the device if the batteries are inserted incorrectly. Add another layer, of either type, and a transistor is created. While the complexity of transistors is beyond the scope of this comment, a silicon chip contains many transistors layered upon each other. Brian, *supra* note 7.
35. Brian, *supra* note 7; *see also* Jason Holden & Christopher Kelty, *The Environmental Impact of the Manufacturing of Semiconductors*, Version 1.2, May 6, 2007, http://cnx.org/content/m14503/latest/ (last visited Jan. 28, 2009).
36. Hildner, *supra* note 2, at 134; *see also* Brito, *supra* note 3, at 2.
37. Brito, *supra* note 3, at 4; *see also* Hildner, *supra* note 2, at 133; Handler, *supra* note 13, at 203.
38. *RFID 101*, *supra* note 8.
39. Curtis Walker, *Tagging Cattle: Mandatory RFID Tags in Michigan*, State Notes: Topics of Legislative Interest, Mar./Apr. 2007, http://www.senate.michigan.gov/sfa/Publications/Notes/2007Notes/NotesMarApr07cw.pdf (last visited Jan. 28, 2009).
40. H.B. 686, 160th Sess., First General Court (N.H. 2007) [hereinafter *NH Bill*]; *see also* Eden, *supra* note 25, at 2, 4.
41. Handler, *supra* note 13, at 199-200.
42. Ziff Davis Media Inc., *Study on Impact of RFID Use Released*, Baseline, 2007, http://www.baselinemag.com/print_article2/0,1217,a=211853,00.asp (last visited Jan. 28, 2009) [hereinafter Davis].
43. GAO-05-551, *supra* note 7, at 2; *see also* Handler, *supra* note 13, at 206 (DOD developed an RFID logistics tracking system called Total Asset Visibility (TAV) after a Gulf War supply shipment was misdirected).
44. Eden, *supra* note 25, at 2; *see also* Brito, *supra* note 3, at 4 (Delta Airlines is using RFID to track passenger bags); Handler, *supra* note 13, at 205 (RFID is used by San Francisco Airport and Delta Airlines).
45. Eden, *supra* note 25, at 2; *see also* Davis, *supra* note 42.
46. Cai Yan, *RFID Market Growing Fast in China*, eeTimes europe, http://www.eetimes.eu/semi/199500924 (last visited Jan. 28, 2009).
47. Eden, *supra* note 25, at 4; *see also* GAO-05-551, *supra* note 7, at 14.

streamline the postal service.[48] Ironically, EPA and Japan think RFID could benefit the environment by tracking toxic wastes along the "cradle-to-grave" chain.[49]

If RFID technology becomes as prevalent as its proponents hope, it will certainly touch every American's life on a daily basis. The sheer number of chips that supporters hope to introduce into the stream of commerce is mind-boggling; RFID chips could literally be everywhere. Item-level tagging in the retail industry will certainly be a major contributor to the number of waste RFID chips. This is why it is so concerning that there is no evidence that EPA has considered the environmental impact of widespread item-level tagging by retailers.

II. Potential Environmental Impact of RFID

Despite containing toxic elements, single semiconductor chips disposed of in landfills do not pose an undue risk to human health because each one contains only trace amounts of toxic substances. However, the sheer volume of chips in the aggregate that could potentially enter the nation's landfills once item-level tagging becomes a reality could pose a significant risk to human health and the environment.

Most environmental concerns surrounding RFID technology focus on how it will negatively affect existing recycling efforts.[50] The metals and other elements in the tags are potential contaminants in traditional cardboard recycling. Industries will need to learn how to isolate the tags and how best to recycle the tags themselves to be able to continue recycling cardboard.[51] Manufacturers, however, remain unconvinced that the trouble associated with removing tags for recycling will be worth the effort.[52]

Absent mandated RFID chip recycling, it is arguable that adverse affects will result, both in reduced traditional recycling and potential contamination of soil and groundwater via leachate. Leachate is the process by which toxic constituents in waste make their way into the nation's soils, groundwater, and surface water supplies. EPA defines leachate as: "Water that collects contaminants as it trickles through wastes, pesticides or fertilizers. Leaching may occur in farming areas, feedlots, and landfills, and may result in hazardous substances entering surface water, ground water, or soil."[53] Although modern landfills employ state-of-the-art design, all solid waste landfills leak.[54] Disposal of RFID chips containing hazardous compounds must be regulated to prevent harm to human health and the environment.

The most common elements used in silicon doping—and the ones most likely to be present in RFID leachate—result in health and environmental effects. Germanium[55] is frequently used in semiconductor manufacture.[56] In gaseous form, inhalation of germanium presents human health effects such as abdominal cramps, burning sensation, cough, and redness and pain in the eyes and on the skin.[57] In the environment as a heavy metal, germanium is considered to negatively affect aquatic ecosystems.[58]

Another important silicon doping element is arsenic,[59] which is one of the most toxic elements known to man.[60] Arsine gas[61] is the most common form of arsenic used in silicon doping and is extremely toxic.[62] Human exposure can occur via food, water, air, and direct contact with contaminated soil or water.[63] Arsenic in water can be taken up by plants and fish and then transmitted to animals and humans via the food chain.[64] Inorganic arsenic is more toxic than organic arsenic.[65] Significant exposure to inorganic arsenic can greatly increase the odds of developing cancer. Very high exposure levels can increase infertility and miscarriages in women, and in both men and women, can cause skin disturbances, heart problems, brain damage, deoxyribonucleic acid (DNA) damage, and reduced resistance to infections.[66] High exposure levels to organic arsenic can cause nerve injury and stomachaches.[67] Arsenic in the environment cannot be destroyed and the amounts introduced by humans spread easily, causing health effects in many locations.[68] Arsine gas specifically has been known to have adverse affects on aquatic ecosystems.[69] Because even small amounts of arsenic can be harmful and because arsenic cannot be eliminated once introduced to the environment, the proper and safe disposal of RFID chips containing traces of arsenic should be a priority.

Even glass-encased RFID chips are potentially toxic. Studies show a correlation between human and pet chip implantation and malignant tumors.[70] VeriChip is the leading provider of implantable chips for humans and pets.[71] The U.S. Food and Drug Administration (FDA) approved the use of VeriChip's

48. Alorie Gilbert, *Electronic Postage Stamps?*, CNET News.com, http://www.news.com/8301-10784_3-5961267-7.html (last visited Jan. 28, 2009).
49. Eden *supra* note 25, at 4; *see also* GAO-05-551, *supra* note 7, at 13; 42 U.S.C. §§6922-6924 (standards applicable to generators, transporters, and owners/operators of hazardous waste treatment, storage, and disposal facilities mandate "cradle to grave" tracking of hazardous wastes from generation to disposal).
50. GAO-05-551, *supra* note 7, at 26.
51. *Id.*
52. *Id.*
53. U.S. EPA, *Terms of Environment: Glossary, Abbreviations and Acronyms*, http://www.epa.gov/OCEPAterms/lterms.html (last visited Jan. 28, 2009).
54. Jennifer Kutz, *You've Got Waste: The Exponentially Escalating Problem of Hazardous e-Waste*, 17 Vill. Envtl. L.J. 307, 310 (2006).
55. The element symbol is (Ge).
56. Lenntech, *Periodic Chart*, http://www.lenntech.com/Periodic-chart-elements/ge-en.htm, (last visited Jan. 28, 2009) (regarding Germanium).
57. *Id.*
58. *Id.*
59. The element symbol is (As).
60. Lenntech, *Periodic Chart*, http://www.lenntech.com/Periodic-chart-elements/as-en.htm, (last visited Jan. 28, 2009) (regarding Arsenic) [hereinafter Lenntech Arsenic].
61. The chemical formula is (AsH_3).
62. Lenntech Arsenic, *supra* note 60.; *see also* Air Liquide, *Arsine*, http://encyclopedia.airliquide.com/sds/en/005_AL_EN.pdf (last visited Feb. 19, 2009) (material safety data sheet for arsine gas) [hereinafter Arsine MSDS].
63. Lenntech Arsenic, *supra* note 60.
64. *Id.*
65. *Id.*
66. *Id.*
67. *Id.*
68. *Id.*
69. Arsine MSDS, *supra* note 62.
70. Todd Lewan, *Chip Implants Linked to Animal Tumors*, Associated Press, Washingtonpost.com, 2007, http://www.washingtonpost.com/wp-dyn/content/article/2007/09/08/AR2007090800997_pf.html (last visited Jan. 28, 2009); *see also* Dr. Katherine Albrecht, *Microchip Implants Cause Fast-Growing, Malignant Tumors in Lab Animals*, Citizens Advocate, http://www.citizensadvocate.net/newsletters/albrechtVeriChipAP.html (last visited Jan. 28, 2009).
71. Lewan, *supra* note 70; *see also* Albrecht, *supra* note 70.

glass-encased RFID chip for humans on January 10, 2005.[72] The FDA claims that VeriChip did not reveal, nor did the FDA discover, independent studies published between 1996 and 2006 that found malignant tumors encasing the implanted chips in lab mice in 1-10% of cases.[73] While findings in lab mice do not necessarily translate to the same risk in humans, leading experts in the cancer field reviewed the research for the Associated Press and concluded there was some cause for concern and more study should be done.[74] Significantly, no expert said that they would receive an implant themselves or allow a family member to have one implanted.[75] The potential for glass-encased chips to cause cancer in laboratory animals strongly suggests that there is also a risk that non-enclosed chips are a significant risk to human health and the environment if deposited in landfills and subjected to leachate.

III. Regulation of RFID Chip Disposal

Rather than create an entirely new federal statute, an existing federal environmental statute is the most practical solution to properly regulate RFID chip disposal. There are three existing federal environmental statutes that could possibly apply to RFID chip disposal. These include the National Environmental Policy Act (NEPA),[76] the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA),[77] and RCRA. Each of these statutes deal with environmental harms and each could possibly regulate RFID, but all contain some kind of loophole or exception within which RFID falls. Thus, these statutes do not, as written, regulate chip disposal. However, EPA could specifically list RFID tags as a hazardous waste so that RCRA would regulate RFID disposal.

Individual states and municipalities are ill-equipped to create and enforce comprehensive regulations that will effectively protect our nation's environmental resources. State regulation is undesirable because national companies would have to adhere to different requirements in each state. Proposed state-level RFID legislation is invariably focused on privacy, generally prohibiting RFID in identification cards such as driver's licenses or requiring prominent notice in retail stores where RFID is in use.[78] Municipal regulation is problematic because the chips are small and difficult to remove and places the burden of safe disposal on consumers, who do not derive any tangible benefit from the chips. Local municipal regulations would need to require residents to pay a fee to dispose of RFID chips as e-waste, like they do now with computer monitors, air conditioners, and mattresses. The fee would then be used to finance chip recycling or proper disposal. Again, this places an unfair financial burden on consumers. Policing and enforcement of state and local regulations would be difficult at best. State and municipal enforcement cannot effectively mandate proper RFID chip disposal because procedures are not already in place, consumers would need to be educated on proper disposal, and personnel are likely to be underfunded and understaffed.

Voluntary industry efforts to regulate proper RFID chip disposal may be an ideal solution, but more than likely retailers would not take on this responsibility absent a legal mandate. The largest retailers are pushing for RFID research and development because they know it will save them money in the long run. These retailers, however, are not providing the bulk of the capital for RFID research and development. By their sheer size and impact on the market, they are able to require suppliers to comply with their demands for RFID enabled products. The process of retailers voluntarily removing RFID chips at the point of sale would incur costs that might severely mitigate the savings that RFID technology presents. Furthermore, without a requirement that the collected chips are reclaimed or disposed of as hazardous waste, stores will probably just throw them out with the rest of their trash anyway. As a result, it is unlikely that retailers will self-impose voluntary standards to accomplish proper disposal.

EPA's response to another relatively new technology is illustrative of the fact that voluntary standards will probably not work for RFID. Recently, EPA took its first steps to formally regulate certain nanomaterials under existing statutory authority.[79] EPA designated nanomaterial a "new" chemical under the Toxic Substances Control Act (TSCA)[80] and formally put carbon nanotube manufacturers on notice that they may be subject to regulation under TSCA.[81] While the efforts to regulate nanomaterials fall under TSCA, it is easy to draw a parallel between nanomaterials and RFID, both relatively new technologies. EPA's decision to abandon efforts to allow the nanomaterials industry to voluntarily regulate itself is evidence that voluntary regulation is ineffective for emerging technologies like RFID.

A. Regulation Under RCRA

RCRA, which governs the disposal of solid and hazardous waste, is the federal statute that is most suited to the regulation of RFID chip disposal.[82] Currently, however, RFID chips would evade regulation under RCRA for three reasons. First, household waste, the likely means of RFID chip disposal, is exempted from RCRA regulation. Second, the total weight of waste RFID chips generated by retailers would be too little to qualify for regulation under even the small quantity generator provision.[83] Finally, RFID chips are not hazardous waste unless they are specifically listed as such by EPA or they fail a toxicity characteristic leaching procedure (TCLP) test. RFID chips are not currently specifically listed as hazardous waste. RFID chips would probably pass a TCLP test because the hazardous substances are present in only trace amounts in each

72. Lewan, *supra* note 70; *see also* Albrecht, *supra* note 70.
73. Lewan, *supra* note 70; *see also* Albrecht, *supra* note 70.
74. Lewan, *supra* note 70; *see also* Albrecht, *supra* note 70.
75. Lewan, *supra* note 70; *see also* Albrecht, *supra* note 70.
76. 42 U.S.C. §§4321-4370d, ELR Stat. NEPA §§2-209.
77. *Id.* §§9601-9675, ELR Stat. CERCLA §§101-405.
78. Brito, *supra* note 3, at 11-12.
79. Goodwin Proctor, Client Alert, *EPA Takes First-Ever Regulatory Actions Aimed at Potential Nanomaterial Risks*, Nov. 6, 2008, http://www.goodwinprocter.com/-/media/B824EFF6CE6546AB87741F4836B92DCF.ashx.
80. 15 U.S.C. §§2601-2692, ELR Stat. TSCA §§2-412.
81. *Id.*
82. 42 U.S.C.A. §6902 (West 2007).
83. 42 U.S.C.A. §6921(d).

individual chip.[84] Therefore, even though RFID chips contain hazardous elements and pose a risk to human health and the environment in large quantities, RCRA, the best statute to govern chip disposal, cannot adequately govern RFID chips unless EPA specifically lists RFID tags as a hazardous waste.

The statute's purpose is to protect health and the environment by prohibiting open dumping of waste, minimizing hazardous waste generation, and requiring proper management of hazardous wastes.[85] Under RCRA, a cradle-to-grave concept governs all hazardous waste from generation to disposal. Generators,[86] transporters,[87] and hazardous waste treatment, storage, and disposal facilities (TSDFs)[88] are all subject to stringent regulation under RCRA. For a product to be regulated under RCRA, it must first be a solid waste.[89] A product is subject to further regulation if it is also a hazardous waste.[90] Thus, for a waste to be hazardous, it must first meet the definition of a solid waste and then also must meet the definition of hazardous waste.

The question remains what kind of waste RFID chips are—solid or hazardous. RFID chips would be "other discarded material" that results from a commercial operation. Other discarded material includes anything that is "disposed of," "thrown away," or "abandoned."[91] Thus, because the chips are abandoned by retailers at the point of sale, they are solid waste under RCRA.[92] To be hazardous waste, and subject to even more stringent regulation, RFID chips must either be specifically listed as a hazardous waste by EPA or must fail a TCLP test.[93] Currently, even though RFID chips are solid waste, it is unclear whether they are hazardous waste as well.

A waste is hazardous if it is either listed as a hazardous waste by EPA or exhibits one of four characteristics.[94] The four characteristics are: (1) ignitability (ability to catch and sustain fire); (2) corrosivity (ability to corrode/dissolve flesh, metal, and other materials); (3) reactivity (likelihood it will explode or undergo violent reactions); and (4) toxicity (tendency to leach harmful chemicals into the soil and groundwater, thus threatening public health and local ecology).[95] A waste exhibits one of the four characteristics if it fails a TCLP test by meeting or exceeding the EPA's proscribed concentrations of various contaminants.[96] Using a representative waste sample, the TCLP test immerses and tumbles the sample in a weakly acidic solution, then tests the resultant leachate.[97] The test is designed to simulate the conditions waste will encounter at the typical landfill.[98]

The simplest way to ensure that RFID chips do not cause widespread harm to human health and the environment is for EPA to specifically list them as hazardous waste under RCRA. Once the product is sold, the chip is no longer used by companies along the supply chain and it becomes waste. Defining RFID chips as waste at the point of sale is critical for EPA to be able to regulate them under RCRA.

Even if RFID chips are a solid hazardous waste under RCRA without EPA specifically listing them as such, there are loopholes that prevent RCRA from covering RFID chip disposal. The household waste exemption is the first reason why RCRA is insufficient to regulate RFID chip disposal. Under RCRA, household waste is exempted from regulation.[99] Exempted household waste includes waste generated at residential sources such as single-family homes, duplexes, multi-family homes, hotels, and motels.[100]

Whether the household waste exception applies to RFID chip disposal turns on questions regarding *who* owns the chip and *when* exactly it becomes waste. Consumers purchase products affixed with RFID tags and take them home. Once out of the range of strategically placed readers, the RFID tags become useless. Affixed to either the product or the packaging, the RFID chip will eventually be disposed of curbside. Municipal waste departments will then pick it up for disposal along with the consumer's other household waste. If the chip

84. 40 C.F.R. §261.24 (2008).
85. 42 U.S.C.A. §6902(3), (5), & (6).
86. Generators of hazardous wastes must keep adequate records of the amount and types of wastes created, properly label appropriate containers used for storage, transport, or disposal, inform transporters and treatment, storage and disposal facilities what the waste is, and use a manifest system to insure that generated wastes are transported by and arrive at licensed facilities. Additionally, generators must submit reports to EPA periodically detailing the amounts, types, and disposition of hazardous wastes generated, as well as what efforts have been made to reduce further generation. *Id.* §6922(a)(1-6).
87. Transporters must keep accurate records concerning the types of hazardous waste transported, as well as where it came from and where it was taken. Transporters also have a responsibility to refuse to transport improperly labeled waste. Further, transporters must comply with the manifest system that binds generators and only transport hazardous waste to permitted treatment, storage, and disposal facilities that the generator indicates on the manifest. *Id.* §6923(a)(1-4).
88. Hazardous waste TSDFs are subject to the most stringent regulations in the cradle to grave scheme. First, all TSDFs must obtain a permit to operate. Permits are not optional; any entity that treats, stores, or disposes of hazardous waste must get a permit, even if treatment, storage, or disposal is part of its normal course of business and it is not in the business of waste management. TSDFs must maintain accurate records regarding all hazardous wastes treated, stored, or disposed of, as well as the manner in which those wastes were treated, stored, or disposed. Facilities must comply with the manifest system and make sure that the wastes they accept are properly labeled, placed in proper containers, and have been properly tracked since "birth" in the cradle-to-grave chain. The construction, design, operation, and maintenance of TSDFs are also regulated. Additionally, contingency plans to minimize any damage that might result from the treatment, storage, or disposal of hazardous wastes are also required. *Id.* §6924(a)(1-6); *see also id.* §6925.
89. The statute defines solid waste as "any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities." *Id.* §6902(27).
90. The statute defines hazardous waste as
> a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may (a) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.

Id. §6902(5).
91. American Mining Cong. v. EPA, 824 F.2d 1177, 1183-84, 17 ELR 21064 (D.C. Cir. 1987).
92. 42 U.S.C.A. §6903(27).
93. 40 C.F.R. §§261.31, 261.32, 261.33(e); *id.* §261.24.
94. Steven Ferrey, Environmental Law Examples and Explanations 289-91 (Aspen Publishers 3d ed. 2004).
95. Rob Courtney, *Evolving Hazardous Waste Policy for the Digital Era*, 25 Stan. Envtl. L.J. 199, 205 (2006).
96. 40 C.F.R. §261.24.
97. Courtney *supra* note 95, at 206.
98. *Id.*
99. 42 U.S.C.A. §6921(i).
100. *Id.* §6921(i)(1)(A)(i).

becomes waste when the consumer disposes it, then the household waste exemption would apply.

Consumers, however, do not use the chip for anything, but because the chip is attached to the product and is "sold" with the product, title to the chip transfers to the consumer at the point of sale, as well as the right to dispose of it with other household waste.[101] The chips attached to products sold at retailers are utilized by the manufacturer, a shipping company, and finally the retailer along the supply chain. The tags are small and the chips are even smaller. Tags are affixed with a sticker, making removal difficult. Since consumers have no use for the chip and would have purchased the item without the chip—indeed, perhaps consumers would *prefer* to purchase the item without the chip—the chip becomes waste at the point of sale. If the chip is waste at the point of sale, then retailers are circumventing federal hazardous waste regulation by sending the chips home with consumers, who will dispose of them with exempted household waste, rather than sending them to a permitted TSDF via a hazardous waste transporter using the cradle-to-grave manifest system.

The second reason why RCRA is insufficient to regulate RFID chip disposal is the small quantity generator exemption. A small quantity generator is exempt from the standards applicable to generators and transporters; treatment, storage, and disposal facilities; land disposal restrictions; and the hazardous waste permit program.[102] To be a small quantity generator, a generator must generate no more than 100 kilograms (kg) and less than 1,000 kg of hazardous waste per calendar month.[103] The volume by weight of waste-RFID chips generated by retailers would be so small that they would not even meet the minimum amounts required to regulate small quantity generators.

RFID tags containing chips ranging in size from a grain of sand to a small pea weigh approximately one-half gram.[104] [105] Retailers must generate over 1,000 kg of hazardous waste to exceed the allowable amount as a small quantity generator and be subject to regulation as a generator under RCRA.[106] Even if retailers tagged every item, it is unlikely they would generate 2,205 lbs. of waste tags per month. To generate that many waste tags, retailers would need to sell more than two million products per month, each affixed with an RFID tag.[107] Retailers generating fewer than 2,205 lbs. of waste tags per month would be small quantity generators under RCRA and as such, would be exempt from hazardous waste regulation.

There is an exception to the small quantity generator exception, however, that could capture RFID chip disposal within RCRA's net. Generators of acute hazardous wastes, those wastes that are listed hazardous wastes by EPA,[108] may generate only 1 kg[109] of hazardous waste per calendar month or else they are subject to the standards applicable to all generators of hazardous wastes.[110] Approximately 2,000 tags would exceed the maximum standard for an acute hazardous waste and hold retailers liable under RCRA as a generator.

RFID chips are not specifically listed as a hazardous waste at this time, but EPA could change that. Absent EPA specifically listing RFID chips as a hazardous waste, the chips would have to fail a TCLP test to find that they are a hazardous waste under RCRA. To fail a TCLP test, the resultant leachate would have to test positive for one of the five forms of arsenic wastes that are listed as acute hazardous wastes.[111] If the TCLP test determines that one of these forms of arsenic is present in RFID chips, then retailers would be regulated under RCRA because a mixture of a non-hazardous waste and a hazardous waste is hazardous.[112] It is unknown whether the trace amounts of arsenic in RFID chips would leach out as one of those five forms.[113] It is highly improbable that silicon-based semiconductor chips contain acute hazardous arsenic wastes given the chips' widespread usage and popularity in many household and commercial products. If silicon-based semiconductor chips were a hazardous waste, requiring stringent disposal methods, it is arguable that manufacturers of products utilizing them would demand a non-hazardous alternative to save costs.

Even if RFID chips did not qualify for the household waste exemption or the small quantity generator exemption, the RFID chips would still need to fail a TLCP test to be subject to RCRA regulations. Clearly, once the chip is sold and is no longer useful to companies along the supply chain it becomes waste, but the question remains whether it is solid hazardous waste. RFID chips would be "other discarded material" that results from a commercial operation; thus the chips are a solid waste under RCRA. To be hazardous waste, the chips must fail a TCLP test for a particular contaminant.[114] To fail the TCLP test for arsenic, for example, and thus be considered hazardous waste, the TCLP test on RFID chips would have to show that there is more than five milligrams[115] per liter of arsenic in the resulting leachate.[116] Thus, if a very small amount of arsenic is found in the resulting leachate, the RFID chips would be hazardous waste and subject to RCRA regulation. The amount of arsenic that goes into making the RFID chips, however, is equally small and it is possible that a small amount of arsenic in the chip would yield a correspondingly small amount of arsenic in the leachate and thus not exceed

101. Smith, *supra* note 4, at 745.
102. 40 C.F.R. §261.5(e).
103. 42 U.S.C.A. §6921(d)(1); 40 C.F.R. §261.5.
104. *Product Specifications for UHF 865 MHz. Gen 2 AD 811 RFID Bar Code Tag—Passive. Model: 115004*, GAO RFID Inc. http://www.gaorfid.com/index.php?main_page=product_info&cPath=122&products_id=632&zenid=5db3a795f22f0548e99cad4dccce92bc (last visited Jan. 28, 2009).
105. One-half gram equals 0.0176 ounces.
106. 1,000 kg is equal to 2204.6 lbs.
107. 2,004,204 tags, each weighing 0.5 grams, would be required to exceed the small quantity generator allowable amount and be subject to RCRA regulation. This does not take into account the fractional weight of the adhesive tag itself, as only the chip's weight would be calculated as a hazardous substance.
108. 40 C.F.R. §§261.31, 261.32, 261.33(e).
109. 1 kg is equal to 2.2046 lbs.
110. 40 C.F.R. §261.5(e)(1).
111. *Id.* §261.33(e) (the five forms are arsenic acid, two types of arsenic oxides, arsenic pentoxide, and arsenic trioxide).
112. U.S. EPA, Training Module: Introduction to Hazardous Waste Identification (40 C.F.R. Part 261), at 21-22 (2005), *available at* http://www.epa.gov/epaoswer/hotline/training/hwid05.pdf (last visited Jan. 28, 2009).
113. Research did not turn up any TCLP test results for silicon-based semiconductor chips or RFID tags or any indication whatsoever that any company or agency has hypothesized that RFID chips could be a problem in the aggregate.
114. 40 C.F.R. §261.24(2008).
115. Five milligrams is equal to .0001765 ounces.
116. *Id.*

the maximum amount allowed under the TCLP test. While a large quantity of RFID chips would likely be toxic and pose a threat, RCRA does not regulate large quantities of waste in the aggregate.

RCRA is the most compatible statute to regulate RFID chip disposal because it deals with solid and hazardous wastes. RCRA, however, is ill-equipped to deal adequately with RFID chips because they will evade regulation via a number of loopholes. First, the household waste exception would exempt from regulation chips that consumers disposed of as part of their regular household waste. Second, even though a great many chips would become waste over the course of one calendar month, they probably will not amount to the over two million that would be required to meet the minimum weight standard for regulation, meaning that retailers would be exempt from RCRA regulation under the small quantity generator exception, unless RFID chips are an acute hazardous waste. Silicon-based semiconductor chips—and RFID chips—are probably not acute hazardous waste because there is no evidence that proper cradle-to-grave disposal procedures must be followed for them. Finally, the trace amounts of arsenic in RFID chips would likely not fail a TCLP test for arsenic, meaning that RFID chips would not be classified as hazardous waste and, thus, would not be subject to RCRA regulation. Therefore, even though RCRA is the statute that should regulate RFID chip disposal, RFID chips will evade hazardous waste designation and RCRA will not regulate chip disposal.

B. Regulation Under CERCLA

Retailers could be held liable for response costs as arrangers under CERCLA, but enforcement under CERCLA is undesirable and insufficient because liability does not attach until there is environmental harm.

To establish a prima facie case of CERCLA liability, a plaintiff must prove four things. First, the site in question must be a "facility."[117] Second, the defendant must be a responsible person: either a current or past owner or operator of a facility, an arranger, or a transporter of hazardous substances.[118] Third, there must be an actual or threatened release of a hazardous substance.[119] Such a release must be of a hazardous substance. CERCLA concerns hazardous substances, not waste. The hazardous substances definition incorporates all the definitions of hazardous substances in all the other federal environmental regulatory statutes but excludes petroleum products for policy reasons.[120] Finally, the release or threatened release must have caused the plaintiff to incur response costs.[121] CERCLA thus regulates places, not people. Thus, owners and operators of facilities, arrangers, and transporters of hazardous substances are potentially responsible parties. CERCLA imposes strict, joint, and several liability so potentially all retailers using RFID would be liable and would have the burden of proving their individual percentage of harm to avoid liability for the entire amount of cleanup costs.[122]

While CERCLA would apply to retailers and hold them responsible as arrangers for environmental harm stemming from RFID chip disposal, it is not the most desirable statute to deal with RFID chip disposal because CERCLA requirements do not attach until a substance is released into the environment and becomes a problem. If CERCLA were the sole statute to regulate RFID chips, no action could be taken until the chips leached out their toxic constituents and contaminated our soils and/or groundwater. CERCLA, thus, regulates retrospectively, not prospectively. Arguably eventual CERCLA liability could deter improper RFID chip disposal, but most potentially responsible parties are not forward-thinking enough to worry about liability arising perhaps decades after disposal. Furthermore, RFID chips must fit within some federal environmental statutory hazardous material definition for retailers to be liable as arrangers. Therefore, CERCLA is not the answer to the RFID chip disposal problem.

C. Regulation Under NEPA

NEPA, considered by some to be the "stop and think" statute, forces all federal agencies to consider the effects their actions will have on the environment before finalizing a particular proposal.[123] NEPA's teeth come from the requirement that major federal actions that may significantly affect the quality of the human environment must be accompanied by an environmental impact statement (EIS).[124] An EIS must contain an analysis of the potential environmental impact, a description of any unavoidable consequences of the proposed action, and a list of alternatives to the proposed action.[125]

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117. CERCLA defines the term facility broadly:
> The term "facility" means (A) any building, structure, installation, equipment, pipe or pipeline (including any pipe into a sewer or publicly owned treatment works), well, pit, pond, lagoon, impoundment, ditch, landfill, storage container, motor vehicle, rolling stock, or aircraft, or (B) any site or area where a hazardous substance has been deposited, stored, disposed of, or places, or otherwise come to be located; but does not include any consumer product in consumer use or any vessel.

42 U.S.C.A. §9601(9).

118. Under CERCLA, liability extends to:
> (1) the owner and operator of a vessel or a facility; (2) any person who at the time of disposal of any hazardous substances owned or operated any facility at which such hazardous substances were disposed of; (3) any person who by contract, agreement, or otherwise arranged for disposal or treatment, or arranged with a transporter for transport for disposal or treatment, of hazardous substances owned or possessed by such person, by any other party or entity, at any facility or incineration vessel owned or operated by another party or entity and containing such hazardous substances; and (4) any person who accepts or accepted any hazardous substances for transport to disposal or treatment facilities, incineration vessels or sites selected by such person, from which there is a release, or a threatened release which cause the incurrence of response costs, of a hazardous substance, shall be liable . . . .

Id. §9607(a).

119. A release is "any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment." *Id.* §9601(22).

120. *Id.* §9601(14).

121. Robert L. Glicksman et al., Environmental Protection: Law and Policy 898 (Aspen Publishers 5th ed. 2007).

122. 42 U.S.C.A. §9601(32); *see also* Glicksman, *supra* note 121, at 909 (CERCLA's defining standard of liability as that applicable to oil spill liability under the Clean Water Act has been interpreted by courts as Congress' intention to impose strict liability).

123. Ferrey, *supra* note 94, at 76.

124. 42 U.S.C.A. §4332(C).

125. *Id.*

NEPA's EIS requirement, however, applies only to major *federal* actions. Federal actions include those conducted by federal agencies, as well as projects receiving federal funding. Tagging by private companies of consumer products with RFID is not a major federal action conducted by or funded by a federal agency. Therefore, manufacturers and retailers are not required to prepare an EIS regarding RFID item-level tagging.[126]

D. State Regulation of RFID

State regulation of RFID technology is the least efficient means of regulation. The retailers that will utilize RFID are national corporations that would likely prefer a national standard that can be implemented at every location, rather than having to adhere to a different standard in each state. A national standard may also be better able to protect the environment by establishing a minimum safety standard for disposal. Additionally, state regulation of RFID technology addresses primarily notice and privacy concerns rather than disposal requirements.[127]

Fourteen states, in fact, have proposed some sort of RFID legislation, but none has enacted legislation regulating RFID disposal.[128] Most of the proposed legislation relates to RFID used in conjunction with consumer products. The following states have proposed variations of a consumer RFID Right-to-Know Act: Arkansas, Massachusetts, Missouri, New Hampshire, New Jersey, New York, Pennsylvania, Tennessee, Virginia, and Washington.[129] California, Michigan, and New Hampshire,[130] have proposed legislation to prohibit RFID chips in identification documents such as driver's licenses.[131] New Jersey has proposed legislation to require all guns sold at licensed firearms dealers to be enabled with an RFID tag.[132] Rhode Island,[133] New Hampshire,[134] and Florida[135] each addressed human implantation in its proposed legislation. The entirety of proposed state legislation regarding RFID relates to privacy, not disposal requirements.

The few states that have proposed deactivating, disabling, or removing RFID tags have given retailers a choice, which will most likely be disabling the tag because that is the easiest solution for retailers. The problem with disabling the tags is that retailers would likely use a tear-away RFID tag, in which the antenna can be pulled off the tag, thereby disabling its ability to transmit and receive data. This would leave the chip, with its toxic constituents, intact for the consumer to bring

126. For NEPA to impact the widespread use of RFID technology, the U.S. Department of State, which had to prepare an EIS when it decided to put RFID chips in every U.S. passport issued after 2006, must have found that there was a potential danger associated with RFID chip disposal. Google searches have not turned up an EIS, EA, or FONSI regarding RFID enabled passports. The search did turn up a document regarding RFID-enabled alien ID cards for border control, but it addressed only privacy concerns related to RFID and not environmental concerns. Significantly perhaps, passports, and ID cards would have a longer shelf life than consumer packaging and the RFID chips inside those forms of identification would not make its way into the waste stream as quickly, thereby leading the government to conclude that disposal in large quantities was not a problem.

127. S.B. 388, 2007-08, Reg. Sess. (Cal. 2007); *see also* H.B. 5091, 94th Leg., First Reg. Sess. (Mich. 2007); S.B. 13, 94th General Assembly, First Reg. Sess. (Mo. 2007); Assembly B. 222, 2007, 230 Ann. Leg. Sess. (N.Y. 2007); H.B. 3848, 104th General Assembly (Tenn. 2005); S.B. 195, 86th General Assembly, 2007 Reg. Sess. (Ark. 2007); H.B. 591, 2006, 108th Reg. Sess. (Fla. 2006); H.B. 276, 149th General Assembly, 2007-08 Reg. Sess. (Ga. 2007); H.B. 573, 95th General Assembly (Ill. 2007); S.B. 159, 185th General Court, 2007 Reg. Sess. (Mass. 2007); H. Con. Res. 42, 94th Leg., First Reg. Sess. (Mich. 2007); S.B. 13, 94th General Assembly, First Reg. Sess. (Mo. 2007); S.B. 210, 94th General Assembly, First Reg. Sess. (Mo. 2007); H.B. 686, 160th Sess., First General Court (N.H. 2007); Assembly B. 3996, 212th Leg., Second Reg. Sess. (N.J. 2006); H.B. 993, 190th General Assembly, 2007-08 Reg. Sess. (Pa. 2007); H.B. 7432, 2005-06 Leg. Sess. (R.I. 2005); H.B. 2190, 2007, 105th General Assembly (Tenn. 2007); H.B. 2086, 2007, Sess. (Va. 2006); H.B. 1031, 60th, First Reg. Sess. (Wash. 2007).

128. Michigan is the only state to require, as of March 1, 2007, that all cattle be marked with a RFID tag before they leaves their place of origin. Michigan is modeling its mandate on the National Animal Identification System (NAIS), a voluntary federal program run by the U.S. Department of Agriculture. (The purpose of both programs is to identify and eradicate cattle diseases before the meat enters the food supply. Michigan's program is limited to cattle, but some agriculturists believe it will soon be applied to other animals, such as swine and poultry, which could mean more labor and expense because the numbers are greater in those industries. Another drawback both in terms of cost and the environment is that the tags cannot be reused and spent tags will likely end up in the trash.) Walker, *supra* note 39.

129. *See* S.B. 195, 86th General Assembly, 2007 Reg. Sess. (Ark. 2007); S.B. 159, 185th General Court, 2007 Reg. Sess. (Mass. 2007); S.B. 210, 94th General Assembly, First Reg. Sess. (Mo. 2007); H.B. 686, 160th Sess., First General Court (N.H. 2007); Assembly B. 3996, 212th Leg., Second Reg. Sess. (N.J. 2006), Assembly B. 222, 2007, 230 Ann. Leg. Sess. (N.Y. 2007); H.B. 993, 190th General Assembly, 2007-08 Reg. Sess. (Pa. 2007); H.B. 2190, 2007, 105th General Assembly (Tenn. 2007); H.B. 2086, 2007, Sess. (Va. 2006); H.B. 1031, 60th, First Reg. Sess. (Wash. 2007) [hereinafter *Privacy Regulations*].

Generally these states would require that retailers provide consumers with notice that RFID is in use, in some cases before the consumer comes in contact with the system, and such notice must be in clear and conspicuous type-size in contrast with the background against which it appears. Some states would require that these signs be placed at the point of sale. Additionally, most of these states would have retailers label the packaging with a logo or identifiable notice that the package contains a RFID tag, again in clear and conspicuous type-size in contrast to the background against which it appears. Retailers would also be required to inform consumers that information can be transmitted both before and after the purchase. In some states, retailers would be required to disable, detach, or destroy the RFID tag at the point of sale. Most states that proposed this provision also would prohibit retailers from reactivating the RFID tags without the consumer's manifest consent. Additionally, some states would also require retailers to provide forms for consumers to request the information gathered via a RFID tag and also its disclosure to the consumer upon such request. The proposed RFID regulation related to consumer products is most interested in protecting consumer privacy and personal information and is not concerned with safe disposal methods. *Privacy Regulations*, *infra*.

130. New Hampshire proposed exceptions to that rule if used to locate persons incarcerated in state prison or county jail, housed in a mental health facility pursuant to court order after having been charged with a crime, those subject to court-ordered electronic monitoring, residents of state/county hospitals, nursing facilities or assisted living facilities. Also exempted would be RFID tags used in toll collecting devices, documents providing access to a secured building or parking area, or identification documents used by the state prior to January 1, 2007. H.B. 686, 160th Sess., First General Court (N.H. 2007).

131. *See* S.B. 388, 2007-08, Reg. Sess. (Cal. 2007); H. Cong. Res. 42, 94th Leg., First Reg. Sess. (Mich. 2007).

132. Assembly B. 4061, 212th Leg., Second Reg. Sess. (N.J. 2006).

133. Rhode Island proposed to "restrict the use of RFID devices for the purpose of tracking the movement or identity of an employee, student or client as a condition of obtaining a benefit or services from such agency." This proposed restriction, however, was limited in that lawful use in state correctional and juvenile facilities, tracking of patients being transported to the hospital in emergency situations and tracking the location and equipment of vehicles owned by the state or local governments would be permitted. H.B. 7432, 2005-06 Leg. Sess. (R.I. 2005).

134. New Hampshire's proposed legislation would prohibit human implantation without written consent. H.B. 686, 160th Sess., First General Court (N.H. 2007).

135. Florida's proposed legislation is enabling rather than prohibiting. It would authorize and encourage the Corrections Department to employ electronic monitoring (RFID) of inmates and incarcerated juvenile offenders. H.B. 591, 2006, 108th Reg. Sess. (Fla. 2006).

home.[136] Even if state legislation required retailers to remove RFID tags, state legislation is the most inefficient way to regulate RFID because every state would have different requirements for retailers to meet.

E. Regulating RFID Locally as E-Waste

E-waste comprises any discarded electronic device such as computers, televisions, cell phones, and DVD players.[137] No definition of e-waste, however, currently includes RFID chips. E-waste disposal is a problem because electronics contain various heavy metals and toxic chemicals.[138]

In the United States e-waste makes up 2-5% of the municipal solid waste stream and is increasing steadily. In Europe, studies suggest that the volume of e-waste is increasing by 3-5% each year—nearly three times faster than the volume of municipal waste.[139] The low cost of goods means that replacement is often easier and less expensive than repairing electronics.[140] As a result, broken and obsolete electronic equipment is discarded much more frequently than in the past and the volume of e-waste is increasing exponentially.[141] Local municipalities have been forced to develop regulations for e-waste disposal because EPA has not defined how e-waste should be disposed.[142] Even if RFID tags were considered e-waste, and emerging regulations governing e-waste encompassed them, these regulations will not effectively control RFID chip disposal because the toxic constituents of RFID chips are not the same as the toxic constituents of e-waste.

Europe is at the forefront of the emerging e-waste regulations. The European Union (EU) has proposed a system called Extended Producer Responsibility (EPR), in which the makers of electronic devices would take responsibility at the time of manufacture for obsolete products by financing and organizing recycling efforts for their products.[143] To help implement EPR, the EU passed the Waste Electrical and Electronic Equipment (WEEE) Directive in 2003.[144] The WEEE Directive incentivizes producers to design their products to make recycling and reuse easier and more feasible as well as requiring producers to collect and distribute information on recycling and reuse.[145] At the same time, the EU also introduced the Restriction on Hazardous Substances (RoHS) Directive which restricts the use of hazardous substances in electronic products.[146] The RoHS Directive targets and mandates the removal of specific chemicals, such as lead, mercury, cadmium, hexavalent chromium, and other toxic elements and chemicals, from the electronics manufacturing process.[147] The RoHS Directive is having an indirect impact on the United States because U.S. export companies must be RoHS compliant to continue to sell products to Europe.[148] As a result, products sold in the U.S. may also be RoHS compliant because it is more efficient for manufacturers.[149] Rather than manufacture goods shipping to Europe differently than those shipping to U.S. markets, manufacturers are simply becoming 100% RoHS complaint.[150] While laws similar to the EU's WEEE and RoHS Directives would benefit the United States by placing more of the burden of dealing with e-waste disposal issues with the manufacturers of electronic equipment, this type of regulation would not address the problems associated with RFID disposal. First, when e-waste is defined, RFID has never been included. This could be because it is still new, but semiconductor chips like those in RFID are not what make computers e-waste. Rather, it is the cathode ray tube monitors and flame-retardant chemicals that are applied to computer plastics that make them e-waste.[151] This does not mean that RFID chips do not present hazards; it is more likely that because the technology is so new, people have not thought about potential environmental hazards. Second, phasing out the same types of chemicals as the EU's RoHS Directive would not affect the hazardous constituents of RFID chips. Third, encouraging mandatory recycling would have a negligible affect on RFID for a number of reasons. Some RFID tags are not recyclable. Tags used in commercial applications are affixed with a sticker making removal difficult without damaging the chip, antenna, or both, even if the tags would be rewriteable and thus, reusable. As a result, while regulations similar to those enacted abroad would have positive results, there would still be a negligible impact on the problems associated with RFID chip disposal.

136. Erika Morphy, *IBM Trims Privacy Concerns With "Clipped Tag" RFID*, TechNewsWorld, http://www.technewsworld.com/story/54179.html (last visited Jan. 28, 2009).

137. Computer Take Back Campaign, Poison PCs and Toxic TVs, Electronics Take Back Coalition 2 (2004), *available at* http://www.computertakeback.com/docUploads/ppcttv2004%2Epdf?CFID=17553870&CFTOKEN=11135182 [hereinafter *Poison PCs*].

138. *Id.* at 3 (citing U.S. EPA, Computers, E-waste, and Product Stewardship: Is California Ready for the Challenge? 13 (2001)).

> As much as 50-80% of the nation's e-waste is exported to developing countries for recycling. Developing countries utilize cheap labor and horrific conditions to dismantle and harvest reusable toxic constituents from e-waste, poisoning people and the environment in the process. RCRA prohibits the export of hazardous wastes absent consent by the receiving country or an international agreement, but e-waste is not considered hazardous waste under RCRA and thus this provision does not apply to exported e-waste. At the 1994 Basel Convention, parties agreed to an immediate ban on the exportation of hazardous wastes. The Basel Ban called for an end to the exportation of hazardous wastes for recycling by the end of 1997. The problem is that the United States has not ratified or agreed to these mandates. *Poison PCs*, *supra* note 137.

139. *Poison PCs*, *supra* note 137, at 2.

140. *Id.*

141. *Id.*

142. GAO-05-551, *supra* note 7, at 26.

143. *Poison PCs*, *supra* note 137, at 6; *see also* Courtney, *supra* note 95, at 211.

144. 2003 O.J. (L 037) [Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE)—Joint declaration of the European Parliament, the Council and the Commission relating to Article 9]; *see also* Courtney, *supra* note 95, at 212.

145. Courtney, *supra* note 95, at 212.

146. 2003 O.J. (L 037) [Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.]; *see also* Courtney, *supra* note 95, at 213.

147. Courtney, *supra* note 95, at 213.

148. *Impact of the RoHS Directive on Electronic Products Sold in the United States*, Inform, Inc., Sept. 2003, http://www.informinc.org/improhs.pdf (last visited January 20, 2008) [hereinafter *Impact of RoHS*]; *see also RoHS*, Lancaster Cables to Go, http://www.cablestogo.com/pdf_files/RoHS.pdf (last visited Feb. 19, 2009) (white paper explaining RoHS, including who must comply).

149. *Impact of RoHS*, *supra* note 148.

150. *Id.*

151. *Poison PCs*, *supra* note 137, at 3.

IV. Conclusion

The best solution to regulate RFID chip disposal and prevent widespread harm to human health and the environment is undoubtedly federal in scope. Dealing with tens of billions, if not trillions, of chips per year is too much to ask of our municipalities alone. A municipal recycling solution would also be impractical because the chips are too small to expect consumers to be able to find and remove easily. Furthermore, the responsibility of removal should not fall on the consumer, who has no use for the RFID chip, but instead should be completed by the retailer at the point of sale. State regulation, even if it dealt with the health and environmental consequences of RFID chip disposal, is inadequate because it is subject to too much variability. Voluntary industry standards are too uncertain for an emerging technology and likely would not develop quickly enough to effectively regulate RFID chip disposal. Whatever regulations are imposed on retailers for RFID chip disposal must be uniform because the retailers that are using RFID technology are large, national companies, which want to implement operating standards across the board in every location.

The three possibly applicable existing federal environmental statutes cannot adequately govern RFID chip disposal for a number of reasons. NEPA will not govern RFID chip disposal because the majority of industries utilizing the technology are private companies, not federal actors. While CERCLA could hold retailers liable for environmental harms as arrangers, it is the least effective means to deal with RFID chip disposal because it is retrospective rather than prospective. The best solution is definitely not to sit around, wait for RFID chips to pollute our natural resources, and then hold retailers responsible for response costs.

Currently, RCRA cannot effectively govern RFID chip disposal because loopholes exist that exempt the chips from regulation. The household waste exemption is perhaps the greatest stumbling block. Retailers are essentially circumventing federal hazardous waste regulation by affixing the tags to consumer products and sending them home with shoppers to be disposed of curbside with other household waste. The only way to force retailers to take responsibility is to have EPA designate RFID chips as a hazardous waste. If RFID chips were hazardous, retailers would have to send them to a permitted TSDF. However, even if RFID chips were hazardous waste, retailers could still be exempted from regulation under the small quantity generator provision unless RFID chips were an acute hazardous waste. Rather than create an entirely new federal statute to deal with RFID chip disposal, the best regulatory solution is for EPA to specifically list RFID chips as hazardous waste under RCRA and require retailers to remove the chip and antenna for disposal at a licensed TSDF.