Volume 20 | Issue 2 Article 2

2009

The No Longer Silent Problem: Confronting Noise Pollution in the 21st Century

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I. INTRODUCTION

Although the problem of noise pollution has a long-standing legacy with humanity, its impacts are only now becoming fully understood. These impacts are not trivial, and both individual governments and the international community have pledged to confront the problem. However, no single magic bullet exists that will solve all noise pollution problems. This is due, in large part, to the difficulty of controlling noise pollution; noise is part of modern life and is often desirable, either as entertainment or for other benefits. While all but the most ardent optimists cannot envision a world without noise pollution, most people nevertheless realize it is necessary to at least manage and control such pollution. Accordingly, we must determine when it becomes necessary to manage noise pollution and how this goal should be achieved. The problem, however, is that this goal is difficult to achieve because attempts to reduce noise pollution, internationally and domestically, are commonly confronted by assertions that such actions are discriminatory[2] or cause undue economic harm.[3] In addition, noise pollution arises in incomprehensible numbers and types. Accordingly, no single solution can be applied to all types of noise pollu-

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2. *See generally* Int'l Civil Aviation Org. [ICAO], *Review of Night Curfew Restrictions*, ICAO Executive Committee, A36-WP/132 (2007) (explaining problems with night curfew for airports); *see also* ICAO, *Consolidated Statement of Continuing ICAO Policies and Practices Related to Environmental Protection*, Assemb. Res. A35-5 (2004), *compiled in Assembly Resolutions in Force*, at I-42, ICAO Doc. 9848 [hereinafter *Consolidated Statement I*] (Oct. 8, 2004) (referencing local noise-related operating restrictions at airports).

3. *See Consolidated Statement I*, *supra* note 2, at I-40 (advising State Parties how to properly implement resolutions to lower noise pollution). Due to difficulties, the ICAO created resolutions which represented a careful balance between the interests of the various State Parties. *Id.* The ICAO called for restraint in the use of such measures. *Id.* If the State parties do implement the resolutions, the ICAO recommends that the resolutions be tailored so that there is a partial rather than a complete withdrawal of operations at an airport. *Id.* Similarly, the ICAO recommends that State Parties consider alternative solutions and take into account the airline industry, airports and environmental interests. *Id.*

tion. Instead, a package of options should be considered, and a "balanced" approach should be adopted to undertake the management of noise pollution.[4]

II. NOISE

There is no physical distinction between sound and noise. Sound is a sensory perception; complex patterns of sound waves are commonly identified in music, speech, or noise.[5] The word "noise" often possesses an element of displeasure that the word "sound" does not. While people may desire sounds, they usually do not desire noise; it is often considered a nuisance because it is the wrong sound, in the wrong place, at the wrong time. Some may identify displeasure with noise because the word "noise" is derived from the Latin word "nausea," meaning sea-sickness.[6] This link may have developed because of the ear's important role in regards to both seasickness and noise.

At birth, the inner ear is fully developed with its full complement of hair cells, supporting cells and nerve fibers.[7] Unlike most other tissues in the body, mammalian hair cells and nerve fibers do not regenerate when damaged.[8] The response of the human ear to sound depends on both the sound frequency, which is measured in Hertz, and the sound pressure on the eardrum, which is measured

4. *See id.* at I-39 (defining origin and meaning of term "balanced approach"); *see also* ICAO, *Consolidated Statement of Continuing ICAO Policies and Practices Related to Environmental Protection*, Assemb. Res. A36-22 (2007), *compiled in Resolutions Adopted by the Assembly*, at 85, (Sept. 18, 2007) [hereinafter *Consolidated Statement II*] (detailing policies and programs based on balance approach for aircraft noise management). The core of the ICAO balanced approach is identifying the noise problem, and then considering the various measures available to reduce the problem through any of four principal elements. *Id.* The four options are (1) reducing the noise at the source through technological change; (2) land-use planning and management; (3) noise abatement operational procedures; or (4) operating restrictions like night curfews. *Id.*

5. *A Scientific Insight Into Noise*, Sri Lanka Sunday Observer, Dec. 30, 2007, *available at* http://www.sundayobserver.lk/2007/12/30/fea01.asp (identifying physical distinction between "sound" and "noise").

6. *See* About Noise and NPC, *About Noise, Noise Pollution, and the Clearinghouse* (last visited Apr. 19, 2009) (explaining latin origin of "noise").

7. *See* WHO, *Occupational and Community Noise*, at 1, Fact Sheet No. 258 (Feb. 2001), *available at* http://www.who.int/peh/Occupational_health/OCHweb/OSHpages/OSHDocuments/Factsheets/noise.pdf [hereinafter WHO Fact Sheet] (explaining ear development in relation to noise).

8. *See* PETER W. ALBERTI, WORLD HEALTH ORG. [WHO], THE PATHOPHYSIOLOGY OF THE EAR, *in* OCCUPATIONAL EXPOSURE TO NOISE: EVALUATION, PREVENTION, AND CONTROL 63, 66 (2001), *available at* www.who.int/entity/occupational_health/publications/noise3.pdf (defining ears' function and regenerative properties).

in decibels (dB).[9] The unit, A-weighted dB(A), is the unit used to indicate the way humans hear a particular sound. A soft whisper at one meter is about 30 dB(A). Noise levels below 30 dB(A), although often audible, are typically recognized as "low-frequency."[10] In isolation, these sounds are usually not considered a nuisance, although at 35 dB(A) noise levels can be annoying.[11] For a good night's sleep, continuous background noise should not exceed 30 dB(A).[12] Although some forms of low-frequency noises may need to be reduced, exposure to individual noises exceeding 45 dB(A) should be avoided.[13] The sound pressure level of normal speech is about 50 dB(A), however, for it to be intelligible and not masked, surrounding sound levels should be less than 35 dB(A).[14] The sound level in a busy restaurant is roughly equivalent to 55 dB(A), while the noise level that can be heard at a very busy intersection is approximately 75 dB(A).[15] Densely traveled motorways may generate noise levels in the range of 75 to 80 dB(A).[16] Music headphones and some music festivals can both exceed 100 dB(A).[17] A chainsaw can reach 110 dB(A).[18] Vehicles called "Boom Cars,"

9. *See* WHO Fact Sheet, *supra* note 7, at 2 (noting metric measurement for noise frequency and pressure).

10. *See generally* GEOFF LEVENTHALL, DEP'T FOR ENV'T., FOOD & RURAL AFFAIRS, A REVIEW OF PUBLISHED RESEARCH ON LOW FREQUENCY NOISE AND ITS EFFECTS 7 (2003), *available at* http://www.defra.gov.uk/environment/noise/research/lowfrequency/pdf/lowfreqnoise.pdf (explaining physics and effects of low frequency noise). Although audibility remains below 20Hz, tonality is lost below 16-18Hz, thus losing a key element of perception. *Id.* Low frequency noise spans the infrasonic and audible ranges and may be considered as the range from about 10Hz to 200Hz. *Id.* The boundaries are not fixed, but the range from about 10Hz to 100Hz is of most interest for the study of low-frequency noise. *Id.*

11. *See id.* at 75 (graphing subjective assessment of noise annoyance during daytime and nighttime).

12. *See id.* (showing graphical comparisons of test noises).

13. *See* WHO, GUIDELINES FOR COMMUNITY NOISE 44-6 (1999), *available at* http://www.who.int/docstore/peh/noise/Comnoise-3.pdf (explaining adverse health effects of noise and sleep disturbance that is caused).

14. *See id.* at 43 (explaining sound pressure levels of interfering noise and effect on speaker strain).

15. See Andy Coghlan, *Dying for Some Peace and Quiet*, NEW SCIENTIST, Aug. 25, 2007, at 6, 6-9 (discussing link between noise pollution and physical illness).

16. *See* GUIDELINES FOR COMMUNITY NOISE, *supra* note 13, at 7 (listing noise sources and noise measurements for sources).

17. See Vlasta Mercier & Beat Hohmann, *Is Electronicaly Amplified Music Too Loud? What do Young People Think?*, NOISE & HEALTH, July-Sept. 2002, at 47, 48 (noting high sound level exposure from electronic devices); *see also* Vlasta Mercier et al., *The Sound Exposure of the Audience at a Music Festival*, NOISE & HEALTH, Apr.-June 2003, at 51, 51 (noting high sound level exposure at concerts and music festivals).

18. *See* Ron Chepesiuk, *Decibel Hell*, 113 ENVIRONMENTAL HEALTH PERSP. A34, A37 (2005) (listing decibel levels of sounds).

equipped with powerful stereo systems, can hit 140 to 150 dB(A), which is equivalent to standing next to a Boeing 747 with its engines at full throttle.[19] The record noise level from high performance motor vehicles is 177 dB(A).[20]

Importantly, unwanted noise is omnipresent. Noise may be of a high or low frequency, and it may come from either nature or human activity. Humans may generate noise through hundreds of different means, ranging from the aircrafts that fly above us, the machinery in our work environments, the gadgets we force into our ears or the wind turbines delivering the clean energy of the future.[21] Generally, each of these sources may be categorized as either "industrial" or "community" sources.

Community noise, which is also referred to as environmental noise, residential noise or domestic noise, is defined as noise emitted from any sources other than industry.[22] The main sources of community noise include road, rail and air traffic, as well as construction and public works.[23] Common sources of indoor noise include ventilation systems, office machines, home appliances and neighboring residents.[24]

While noise is ubiquitous in modern life, silence is a rarity, and unfortunately, is not always valued. For example, until recently, the Sony Corporation marketed amplifiers and speakers with a "disturb the peace" advertising campaign that boasted of "new ways to offend."[25] The invisibility of noise pollution as a problem is ironic, because the need to control noise pollution has a legal pedigree dating back to antiquity. Moreover, a growing recognition that noise pollution can have a detrimental impact on both humans and

19. *See id.* (listing decibel level of Boeing 747 airplane).

20. *See id.* (measuring sound pressure levels from drag racing noise).

21. *See* Convention on the Conservation of Migratory Species of Wild Animals, *Wind Turbines and Migratory Species*, Res. 7.5 (Sept. 18-24, 2002) (on file with the author), *available at* http://www.cms.int/bodies/COP/cop7/proceedings/pdf/en/part_I/Res_Rec/RES_7_05_Wind_Turbine.pdf (expressing concern regarding wind turbines on migratory birds); *see also* Kamaal Zaidi, Wind Energy and Its Impact on Future Environmental Policy Planning: Powering Renewable Energy in Canada and Abroad (2006) (unpublished comment, on file with bepress Legal Series), *available at* http://law.bepress.com/cgi/viewcontent.cgi?article=4706&context=expresso (stating noise pollution considered in wind site development).

22. *See* GUIDELINES FOR COMMUNITY NOISE, *supra* note 13, at xvi (defining environmental noise).

23. *See id.* at 19 (listing most common community noise sources).

24. *See id.* at 5 (listing most common indoor noise sources).

25. *See* Charles W. Schmidt, *Noise That Annoys: Regulating Unwanted Sound*, 113 ENVIRONMENTAL HEALTH PERSP. A42, A43 (2005) (describing Sony's campaign for amplifiers with extreme sound capability).

animals has caused a recent reinvigoration of this pedigree both nationally and internationally.

III. THE IMPACTS OF NOISE POLLUTION

Although environmental burden and impact assessments are difficult in all fields, the assessment is especially difficult with certain forms of noise pollution such as low-frequency noise.[26] There are six main reasons for these difficulties. First, the numerous outcomes and complicated causal pathways involved in noise exposure and its effects make it difficult to quantify the detrimental impacts.[27] Second, unlike drugs, chemicals or other pollutants, noise pollution leaves no residue in the body.[28] Third, noise pollution is often related to other forms of pollution, and it is difficult to differentiate the impacts of these forms of pollution.[29] Fourth, exposure to the same levels of noise pollution can impact people differently. This is particularly the case when dealing with low-frequency noise, to which some people are more sensitive.[30] This heightened sensitivity may be due to any number of reasons and can cause great suffering.[31] Fifth, noise pollution can effect people mentally as opposed to physically, which compounds the problem of recognizing its impact.[32] Finally, the pollution may be cumulative and derived from an ongoing source, rather than one or two large-scale events.[33]

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26. *See* DAVID KAY & ANNETTE PRÜSS, WHO, METHODOLOGY FOR ASSESSMENT OF ENVIRONMENTAL BURDEN OF DISEASE (2000) (explaining difficulty in assessing risk factors of noise pollution).

27. *See* Schmidt, *supra* note 25, at A44 (2005) (noting exposure to high noise levels increases potential for hearing loss, colds and other illnesses).

28. *See id.* (finding pollution leaves little trace on human bodies).

29. *See* D. Schwela et al., *Confounding or Aggravating Factors in Noise-Induced Health Effects: Air Pollutants and Other Stressors*, NOISE & HEALTH, July-Sept. 2005, at 41, 41-50 (discussing noise pollution and air pollution interaction which makes it difficult to assess only noise pollution effects).

30. *See* H.G. Leventhall, *Low Frequency and Noise and Annoyance,* NOISE & HEALTH, Apr.-June 2004, at 59, 59-60 (distinguishing those who have heightened sensory response from those who have low sensory responses to noise).

31. *See id.* (stating those with sensitivity to low-frequency sound can experience extreme distress from constant noise); *see generally* G. Belojevic et al., *Noise and Mental Performance: Personality Attributes and Noise Sensitivity,* NOISE & HEALTH, Oct.-Dec. 2003, at 77, 77-89 (explaining people with noise sensitivity struggle with mental performance).

32. *See* Leventhall, supra note 30, at 69 (expressing challenges detecting noise pollution).

33. *See* H. Ising et al., *Low Frequency Noise and Stress: Bronchitis and Cortisol in Children Exposed Chronically to Traffic Noise and Exhaust Fumes,* NOISE & HEALTH, Apr.-June 2004, at 21, 21-28 (noting high exposure to traffic noise at night can cause bronchitis in child).

Until recently, such difficulties resulted in a lack of international scientific agreement on the methodologies for estimating the forms of noise pollution and its impacts (for example, whether annoyance is actually a health issue).[34] Accordingly, pivotal international players, such as the World Health Organization (WHO), have recently begun to harmonize the research methodologies for noise pollution.[35] Current attempts to synchronize and solidify the research into international databases are highly desirable because they will lead to an easier and more effective method of forecasting the possible impact of policies and preventative actions on noise pollution.[36] Yet, because substantive scientific debate remains in a number of areas, international, national and regional legislators should adopt a precautionary approach until a greater scientific consensus is reached regarding noise pollution.[37] Importantly, such an approach would be fully consistent with the expectations of international environmental law.[38]

As of 2007, an estimated 113 million Europeans have been exposed to noise levels which are high enough to cause serious health problems.[39] It is estimated that more than half of all European residents live in zones which do not ensure acoustic comfort due to noise emissions which are deemed to be "annoying."[40] The annoy-

34. *See* STATE HEALTH AGENCY OF BADEN-WÜRTETEMBERG, STUTTART, GERMANY, 23-24 JUNE 2005, WHO, EXPERTS CONSULTATION ON METHODS OF QUANTIFYING BURDEN OF DISEASE RELATED TO ENVIRONMENTAL NOISE 1-3 (2007), *available at* http://www.euro.who.int/Document/NOH/EDB_mtgrep.pdf (discussing international experts' conference to define burden of disease from environmental noise).

35. *See id.* (listing World Health Organization efforts to collect noise data).

36. *See id.* (addressing possible impact of policies for noise pollution control).

37. *See* GUIDELINES FOR COMMUNITY NOISE, *supra* note 13, at 17 (recognizing sources of and guidelines for noise).

38. *See generally* Alexander Gillespie, *The Precautionary Principle in the Twenty-First Century: A Case Study of Noise Pollution in the Ocean*, 22 INT'L J. MAR. COASTAL L. 61, 61-87 (2007) (discussing precautionary principles as applied to noise pollution in international community).

39. *See* EUR. COMM'N, QUALITY OF LIFE AND MGMT. OF LIVING RES., KEY ACTION 4: ENVIRONMENT AND HEALTH 17, *available at* http://ec.europa.eu/research/quality-of-life/ka4/pdf/brochureka4_en.pdf [hereinafter KEY ACTION 4] (finding large portion of European Union affected by dangerous levels of noise pollution).

40. *See generally* Gillespie, *supra* note 38, at 61-87 (examining difficult noise environments for European residents). In the material related to noise pollution, some commentators refer to noise pollution as "emissions" while others refer it to "immissions". To immit is defined as "to introduce, insert, inject or admit things material or immaterial" and to emit is defined as "to send forth, or to discharge." OXFORD ENGLISH DICTIONARY (2d ed. 1989). The use of the word "immissions" appears to give noise pollution somewhat of a novel identification, as different from the more conventional term "emissions," which is found in discussions of more commonly recognized forms of pollution, ranging from air to climate. As it is this Article's contention that noise pollution is not substantively different from

ance level depends upon the emission's parameters, including, *inter alia*, its intensity, regularity and duration of exposure. In addition, some people are more sensitive than others. During the daytime, few people are highly annoyed at levels below 55 dB(A), and few are moderately annoyed at levels below 50 dB(A).[41] Although annoying noise, especially at low frequencies, is a clear and real concern for many people, it is difficult to pinpoint hard science which can identify the exact lasting difficulties such noise can cause.[42]

Moreover, there is growing evidence that noise levels above low-frequencies have significant impacts. The most obvious example of noise pollution's detrimental impact is hearing loss.[43] Hearing loss, or "impairment," measures the reduction in a person's ability to hear when compared to that of a normal person. It tends to be minimal in people up to thirty years old, but increases rapidly with age and can be further accelerated by noise pollution.[44] In Europe, ten million people are exposed to community noise levels that may lead to hearing loss, and thirty million are exposed to occupational noise that endangers their hearing.[45]

Aircraft noise, for example, affects about fifteen percent of the European population.[46] In the United States, as many as forty million people are exposed to potentially hazardous noise.[47] Furthermore, an estimated sixty-five percent of Europe's population is exposed to ambient sound levels of about 55 dB(A), and about seventeen percent are exposed to levels above 65 dB(A).[48] Signifi-

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other forms of pollutants, this Article prefers to link them all together using the term "emissions."

41. *See* GUIDELINES FOR COMMUNITY NOISE, *supra* note 13, at xii (emphasizing differences in annoying noise levels during night and day).

42. *See* LEVENTHALL, *supra* note 10, at 28-30 (discussing difficulty of pinpointing real noise problem).

43. *See id.* at 25 (showing deleterious impacts of high noise levels on hearing loss).

44. *See id.* at 13-14 (explaining noise pollution thresholds for people of different ages).

45. *See* KEY ACTION 4, *supra* note 39, at 17 (describing study findings).

46. *See Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions: Air Transport and the Environment, Towards Meeting the Challenges of Sustainable Development*, at 5, COM (1999) 640 final (Jan. 12, 1999) [hereinafter *Communication from the Commission to the Council*] (addressing impact of aircraft noise on European Union population).

47. Richard H. Gilully, *Noise: The Unseen Pollution*, SCI. NEWS, Mar. 18, 1972, at 189 (examining exposure to potentially hazardous noise).

48. *See* Chepesiuk, *supra* note 18, at 35-38 (discussing causes of increased loud noises); *see also* Susan M. Booker, *EC Says Shhh*, 109 ENVTL. HEALTH PERSP, A204, A204 (2001) (explaining EU's goal to reduce causes of noise pollution and detrimental effects).

cantly, 65 dB(A) is generally identified as the level which can lead to increased cardiovascular risk.[49]

Additionally, there is also consistent evidence that noise above 80 dB(A) causes reduced cooperative behavior, and that loud noise can increase aggressive behavior in individuals predisposed to aggressiveness.[50] Moreover, brief exposure to sound levels exceeding 120 dB(A), even if fleeting, may cause physical pain.[51] Thus, while rock concerts, typically reaching 100 dB(A), may cause temporary hearing impacts in attendees, such as a ringing in the ear known as transient tinnitus, the musicians themselves may develop permanent hearing loss due to prolonged exposure.[52]

In 2007, the WHO issued preliminary findings suggesting that long-term exposure to traffic noise alone may have detrimental impacts beyond annoyance and sleep disturbance.[53] Also, long-term exposure may account for three percent of deaths from ischemic heart disease in Europe.[54] Seven million people around the globe die from heart disease annually, and, in Europe, approximately 210,000 deaths occurred from heart disease resulting from exposure to high noise levels.[55]

The noise threshold for cardiovascular problems is between 55 and 65 dB(A) or above for chronic nighttime exposure.[56] At night, an estimated thirty percent of Europeans are exposed to sound

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49. *See* H. Ising & B. Kruppa, *Health Effects Caused by Noise: Evidence in the Literature from the Past Twenty-Five Years*, NOISE & HEALTH, Jan.-Mar. 2004, at 5, 5 (noting certain noise levels increase cardiovascular risk).

50. *See* GUIDELINES FOR COMMUNITY NOISE, *supra* note 13, at 10 (recognizing noise's affect on group behavior). At this noise level, children have a greater increased feeling of helplessness. *Id.*

51. *See* Chepesiuk, *supra* note 18, at A36 (recognizing that high levels of noise can cause physical pain).

52. *See* GUIDELINES FOR COMMUNITY NOISE, *supra* note 13, at xiii (generalizing effects of ceremonies, festivals and various types of loud entertainment on young people and performers).

53. *See* G. Bluhm et al., *Road Traffic Noise and Annoyance - An Increasing Environmental Health Problem*, NOISE & HEALTH, July-Sept. 2004, 43, 43 (discussing detrimental effects of traffic noise); *see also* B. Griefahn & M. Spreng, *Disturbed Sleep Patterns and Limitations of Noise*, NOISE & HEALTH, Jan.-Mar. 2004, at 27, 31 (noting transportation noises often cause sleep disturbance).

54. *See* GUIDELINES FOR COMMUNITY NOISE, *supra* note 13, at 47-48 (correlating heart disease deaths with exposure to traffic noise and other elements of noise pollution); *see also* Coughlan, *supra* note 15, at 6-9 (discussing effect of long-term exposure to traffic noise on cardiovascular health).

55. *See* Coughlan, *supra* note 15, at 6-9 (reporting evidence of noise causation of heart disease).

56. *See* GUIDELINES FOR COMMUNITY NOISE, *supra* note 13, at 47 (giving confidence intervals for heart disease and cardiovascular problems).

pressure levels exceeding 55 dB(A),[57] and such exposures can lead directly to sleep disturbance, another commonly recognized impact of noise pollution.[58] In addition, the effects of nighttime exposure to noise may also include difficulty falling asleep, disruption of sleep patterns and awakening people who are already asleep. This disturbance is significant, because "sleep is a restorative process during which the body's organs renew their supply of energy and nutritive elements."[59]

Additionally, work-related noise pollution may have a distinct impact on employees. Due to the great diversity of industrial sites within and between countries, particularly in developing countries, it is often difficult to pinpoint average levels of noise emissions. Nevertheless, oil, fertilizer and chemical industry worksites have emitted an average of 92 to 95 dB(A).[60] In addition, average sound levels range between 92 to 96 dB(A) in foundries, shipyards, breweries, weaving factories, and paper and saw mills, although peak values have been recorded between 117 and 136 dB(A).[61]

Yet, levels of noise pollution may vary significantly even within the same industrial site. For example, while some automobile plants have an average noise level of 80 dB(A), this level can exceed 90 dB(A) in the hammering section of the plant.[62] Likewise, within a ship, the average noise level may be around 85 dB(A), but engine room noise levels may be as high as 114 dB(A).[63] These differences occur because some types of machinery generate greater noise; air jets, for instance, which are widely used for cleaning, drying, running power tools and steam valves, can generate sound levels up to 105 dB(A).[64] Similarly, in the woodworking industry, the sound level of a saw can be as high as 106 dB(A).[65]

Susceptible individuals may develop permanent defects, such as hypertension and ischemic heart disease, after prolonged expo-

57. *See id.* at iii (emphasizing effects of night-time noise).

58. *See id.* at 44-46 (highlighting sleep disturbance as major effect of noise pollution in home settings).

59. S. P. SINGAL, NOISE POLLUTION AND CONTROL 78 (2000) (explaining necessary functions of sleep).

60. *See* S. Kameswaran, *Noise Pollution in the Workplace,* SCI. TODAY, Aug. 1982, at 51, 54 (discussing noise levels in workplaces across different industries).

61. *See id.* (discussing workplace noise levels across industries).

62. *See id.* (noting average levels of noise in automobile plants).

63. See Kumar Murty, *Airborne Noise on Board Ships,* 25 J. ACOUSTIC SOC'Y INDIA 15.1, 15.1-15.5 (1997) (describing average levels of noise in ship engine rooms).

64. *See* Who Fact Sheet, supra note 7, at 3 (highlighting hearing damage thresholds for air jets used in power tools).

65. *See id.* (explaining average levels of noise in woodworking industry).

sure to high sound levels.[66] Workers exposed to high levels of industrial noise over a period of five to thirty years may show increased blood pressure and higher risk for hypertension.[67] Cardiovascular effects have also been demonstrated after long-term exposure to air and road traffic, with values of 65 to 70 dB(A).[68] In fact, prolonged exposure to very loud noise levels, between 90 and 115 dB(A), has been linked to suicide.[69] According to the WHO, approximately thirty million people in the United States were exposed to a daily occupational noise level above 85 dB(A) in 1990, as compared to the approximate nine million exposed in 1981.[70] Significantly, those exposed worked mostly in the production and manufacturing industries.[71] In Germany and other developed countries, some four to five million people, twelve to fifteen percent of all those employed, are believed to be exposed to noise levels of 85 dB(A) or higher.[72]

Studies have shown that noise can adversely affect the performance of cognitive tasks, primarily in workers and children. Although noise-induced arousal may produce better performance of simple tasks in the short-term, cognitive performance substantially deteriorates for more complex tasks.[73] Children who are chronically exposed to aircraft noise under-perform in proof reading, persistence on challenging puzzles, tests of reading acquisition and motivational capabilities.[74] Moreover, it is believed that prolonged exposure above 55 dB(A) during the day or night has a negative

66. Elise E. M. M. van Kempen, et al., *The Association Between Noise Exposure and Blood Pressure and Ischemic Heart Disease: A Meta-analysis*, 110 ENVTL. PERSP. 307, 307 (2002), *available at* http://www.pubmedcentral.nih.gov/picrender.fcgi?artid=1240772&blobtype=pdf (listing potential effects of long-term noise exposure).

67. *See id.* at 315 (discussing blood pressure and hypertension noise pollution effects).

68. *See* WHO Fact Sheet, *supra* note 7, at 5 (outlining noise pollution thresholds for commercial, industrial and traffic areas).

69. *See* Janet Raloff, *Airport Noise Linked with Heart Disease*, SCI. NEWS, May 7, 1983, at 294 (explaining links between heightened noise levels and particular diseases).

70. *See* WHO Fact Sheet, *supra* note 7, at 1 (noting ten-year increase in noise levels for industrial and manufacturing industries).

71. *See id.* (noting specific industries of increased noise pollution effects).

72. *See id.* at 2-4 (noting average levels of noise experienced by typical person)

73. *See generally* M.P. Matheson et al., *The Effects of Chronic Aicraft Noise Exposure on Children's Cognition and Health*, NOISE & HEALTH, Apr.-June 2003, 31, 31 (explaining research results showing decreasing rates of aptitude in children completing complex, long-term and simple tasks).

74. *See id.* (enumerating various learning activities that can be affected by heightened noise levels).

impact on a child's learning ability.[75] Even repeated, but ad-hoc, exposure, such as living in the vicinity of a major airport, may negatively impact a child's memory.[76]

Noise pollution generally affects animals in the same way it affects humans. The most observable effect of noise on wild animals appears to be behavioral.[77] Many animals learn to differentiate among acoustic stimuli and to adapt and live with different types of noise pollution.[78] Other animals, however, have gone in the opposite direction, and have shown a strong sensitivity to noise pollution.[79] It has been known for decades that birds may have certain unique sensitivities.[80] For example, a 1950 study showed that adult condors were very sensitive to noise and would abandon their nests when disturbed by blasting sonic booms or even traffic noise.[81] Since then, additional studies have shown that some bird species have changed their singing patterns, to compete with other noise, or the times at which they sing.[82] Some species, especially those reliant upon their song, have seen their pairing success rates fall by up to fifteen percent due to their inability to compete with other noise sources.[83]

75. *See* Coughlan, *supra* note 15, at 6-9 (noting impact of noise levels on children's learning abilities).

76. *See generally* T. Matsui, *Children's Cognition and Aircraft Noise at Home- The West London Schools Study*, NOISE & HEALTH, Oct.-Dec. 2004, 49, 49-58 (discussing detrimental effect of proximity to heightened noise levels on memory retention).

77. *See* Carl Hopkins, *Effects of Noise on Wildlife*, 29 BIOSCI. 547, 547 (1979) (describing effects of noise pollution on wildlife).

78. *See id.* (explaining adaptive evolution in animals in response to noise pressures).

79. *See id.* (noting some animals show adverse reactions to various types and frequencies of noise).

80. *See generally* Adam Anthony, *Noise Stress in Laboratory Rodents*, 31 J. ACOUSTIC SOC'Y AMER. 1430 (1959) (explaining noise sensitivity in birds).

81. *See id. at 1437-40* (citing studies showing effect of noise pollution on condors).

82. *See* L. Potash, *A Signal Detection Problem and Possible Solution in Japanese Quail*, 20 ANIMAL BEHAV. 192, 192 (1972) (discussing changes in bird behavior as result of increased noise pollution).

83. *See* Ed Yong, *City Songbirds Are Changing Their Tone*, NEW SCIENTIST, Mar. 29, 2008, at 33, 33 (detailing effect of noise pollution on birds); *see also* Sara Goudarzi, *Noise Pollution Threatens Birds*, LIVESCIENCE, Nov. 1, 2007, http://www.livescience.com/animals/061101_ovenbird_noise.html (discussing impact of noise on birds mating); *see also* Mark Kinver, *City Birds Sing for Silent Nights*, BBC NEWS, Apr. 27, 2007, http://news.bbc.co.uk/2/hi/science/nature/6591649.stm (noting decreased mating activity in birds due to drowning out of mating calls).

IV. THE COMMITMENT TO CONTROL NOISE POLLUTION

Martial, one of Julius Caesar's generals, complained in the Roman Senate that the clattering of chariots on Rome's cobblestone streets was so loud at night that it sounded as though all of Rome was traveling through his bedroom.[84] The noise pollution problem later arose in the 19th Century, when both Arthur Schopenhauer in the 1820s and Charles Dickens in the 1880s tried to bring noise pollution to the attention of both politicians and the general public.[85] These concerns coincided with the increasing urbanization and industrialization of society and an accompanying increase in unwanted noise emissions.[86]

Despite increased noise emissions, legal responses took time to develop. Notwithstanding the slow development of accurate measurements of noise, traditional mechanisms of the common law, such as "nuisance law," were assumed to be sufficient to deal with this problem.[87] Traditional common law recognized noise pollution as either a public "nuisance," if a class of citizens were impacted, or a private "nuisance," if it only concerned an individual.[88] Accordingly, plaintiffs sought legal remedy for the defendants' noise pollution under nuisance law by claiming that the noise denied them the use or enjoyment of their land.[89] In an attempt to determine whether the defendant's use of the land was unreasonable, the primary thought process was to balance the respective interests of the defendant and the plaintiff.[90] The unreasonableness was subject to what was ordinary in that particular area[91] "according to the plain and sober and simple notions of the English people."[92] Typically, ongoing, non-trivial noise pollution that could deprive a

84. See T. Embleton, *Noise Control from the Ancient Past*, NOISE NEWS, Mar.-Apr. 1977, at 26, 26 (explaining various stories of noise concerns throughout human history).

85. *See* THE WORKS OF SCHOPENHAUER 213 (Will Durant, ed., Simon & Schuster 1928) (noting historical movement towards recognizing noise as form of pollution).

86. See T. Embleton, *supra* note 84, at 26 (discussing Martial's complaint about Roman noise pollution).

87. *See* Heath v. Mayor of Brighton, (1908) 98 L.T. 718 (Eng.) (explaining potential for actionability of various types of noise pollution).

88. *See* Barber v. Penley, (1893) 2 Ch. 447 (Eng.) (explaining various types of nuisances under common law).

89. *See* St. Helen's Smelting Co. v. Tipping, (1865) 11 Eng. Rep. 1483 (H.L.) (holding plaintiffs may seek damages for noise pollution via nuisance actions).

90. *See id.* (outlining court balancing test).

91. *See* Sturges v. Bridgeman, (1879) 11 Ch.D. 852 (holding what constitutes reasonable use of one's property depends on character of locality).

92. Walter v. Selfe, (1851) 64 Eng. Rep. 849, 851 (Ch.) (establishing test for determining reasonableness).

person of ordinary sensibilities from sleeping at night would be actionable as a nuisance.[93] Such actions could easily be compensated with damages, but injunctions were sometimes necessary to actually stop the noise.[94]

Due to the fact that noise pollution has grown both domestically and internationally, specific laws, regulations and guidelines for individual noise sources are increasingly replacing the common law approach. These ongoing developments followed the creation of the first guidelines for noise standards that evolved in the 1950s and 1960s. The United States Noise Control Act of 1972 is a leading example of this type of new legislation.[95] With this Act, Congress found that "inadequately controlled noise present[ed] a growing danger to the health and welfare of the Nation's population, particularly in urban areas," and declared that it was "the policy of the United States to promote an environment for all Americans free from noise that jeopardizes their health or welfare."[96] That same year, the noise pollution problem gained an international dimension when it appeared on the agenda of the 1972 Stockholm Conference on the Human Environment.[97] Following debate, Recommendation 14 of the Programme of Action recommended that an

> intergovernmental body for environmental affairs [. . .] be established within the United Nations [to] ensure that the required surveys shall be made concerning the need and the technical possibilities for developing internationally agreed standards for measuring and limiting noise emissions and that, if it is deemed advisable, such standards shall be applied in the production of means of transportation and certain kinds of working equipment, without a

93. *See* Heath, 98 L.T. at 718 (explaining potential for actionability of various types of noise pollution).

94. *See* Allen v. Gulf Oil Refining, (1980) Q.B. 156, 156 (Eng.) (explaining injunction necessary to prevent future noise pollution).

95. *See* 42 U.S.C. § 4901 (2006) (establishing national policy to promote environment free of excessive noise pollution).

96. Noise Control Act of 1972, Pub. L. No. 92-574, § 2(a)-(b), 86 Stat. 1234 (1972) (amended 1978) (current version at 42 U.S.C. § 4901(a)-(b) (2006)) (noting United States governmental policy towards noise in everyday environment).

97. *See* Conference on the Human Environment, Stockholm Swed., June 5-16, 1972, *Action Plan for the Human Environment*, ¶ 7, Recommendation 14 (adopting recommendations for environmental action at international level).

large price increase or reduction in the aid given to developing countries.[98]

Yet, despite the strong start and notable work in key domestic jurisdictions such as the United States,[99] the noise pollution issue fell to the wayside of domestic politics. Although the Noise Control Act remained in force, the Reagan Administration concluded that noise issues were best handled at the state or local level.[100] As a result, the Environmental Protection Agency (EPA), the central oversight body, lost funding, and the noise pollution issue lost prominence.[101] The topic did not regain prominence until the 1990s, when the noise pollution issue appeared on the international agenda for the 1992 Earth Summit.[102] Agenda 21 of the conference recommended the development of nationally determined action programs and the development of criteria for maximum permitted safe noise exposure levels, noise assessments, and controls as part of environmental health programs.[103] Some high-level domestic developments in countries such as the United Kingdom supplemented Agenda 21 when noise pollution, and its management, came to the fore.[104] Additionally, some areas within the United States substantially updated their local laws on noise pollution and adopted advanced standards.[105]

While these improvements are commendable, the problem of noise pollution has not been resolved. Yet, surprisingly, the topic of

98. *Id.* (encouraging establishment of environmental group to create noise pollution standards).

99. *See id.* (referring to progress made with noise control regulations). The Act, incorporating the 1978 Quiet Community Act Amendments, mainly limited noise of civil aircrafts and other civil transportations. *Id.*

100. *See* Schmidt, *supra* note 25, at A43 (attributing lack of federal noise standards to Reagan Administration in early 1980s).

101. *See id.* (further discussing lack of federal noise standards stemming from Reagan Administration).

102. Conference on Env't & Dev., June 3-14, 1992, *Agenda 21*, ¶ 41, U.N.Doc A/CONF.151/26 (Aug. 12, 1992) (reintroducing noise pollution as international priority).

103. *See id.* (describing Agenda 21 summit recommendations).

104. *See* Hatton v. United Kingdom, App. No. 36022/97 (U.K. July 8, 2003), http://www.echr.coe.int/eng/Press/2003/july/JudgmentHattonGC.htm (discussing noise pollution from UK's Heathrow Airport and effects of noise pollution). *See also* Rhona K. M. Smith, *International Decision: Hatton v. United Kingdom*, 96 AM. J.INT'L L. 692, 692-99 (2002) (noting local law and regulations against noise pollution).

105. *See New Yorkers to Get Quieter Night's Sleep*, NEW SCIENTIST, July 14, 2007, at 4 (describing updates in New York City's Noise Code). In 2007, New York City's thirty-year-old Noise Code was updated to account for new noise sources. *Id.* It also promised heavy fines on music "polluters" and towing of cars if alarms go off for more than three minutes per night. *Id.*

noise pollution did not appear at the 2002 World Summit on Sustainable Development (WSSD),[106] and this omission from the WSSD Plan of Implementation was particularly notable. Although the global community did not acknowledge the problem, the European Community (EC) committed itself to reduce noise pollution in the Sixth Environmental Action Programme for the period of 2002-2012.[107] In particular, the EC pledged to "substantially reduce [ ] the number of people regularly affected by long-term average levels of noise."[108] The EC intends to pursue these objectives through creating action plans that better measure noise emissions from services and products and in certain noisy areas.[109] The EC plans to complete action plans by the middle of 2008 in order to better manage and mitigate noise pollution.[110] Likewise, a number of major international bodies which govern industries that generate particular types of noise pollution have committed themselves to controlling and reducing their various noise emissions, such as aviation through the International Civil Aviation Authority,[111] railways through the International Union of Railways,[112] and motor vehicles

106. *See* World Summit on Sustainable Development: Johannesburg, August 26 – September 4, 2002, http://www.worldsummit2002.org (last visited Feb. 23, 2009) (addressing numerous issues, but not noise pollution as worldwide concern).

107. *See* Council Decision 1600/2002, Laying Down the Sixth Community Environmental Action Progamme, art. 7, 2002 O.J. (L 242) 12 (EC) (discussing EC's goals regarding noise).

108. *Id.* at 10 (stating EC's commitment to reducing number of people affected by long-term average noise levels) (brackets added).

109. *See* Council Directive 2002/49, Relating to the Assessment and Management of Environmental Noise, art. 7, 2002 O.J. (L 189) 4 (EC) (identifying statistics of places with heightened levels). Places of note that have heightened noise levels include (reformatted explanatory note for increased clarity) near the major roads, which have more than 6,000,000 vehicle passages a year; along major railways, which have more than 60,000 train passages per year; around major airports; and agglomerations with more than 250,000 inhabitants. *Id.*

110. *See id.* at 4-5 (defining terms of Directive). The action plans must meet minimum requirements (see Annex V) and be revised if necessary, when a major development occurs affecting the existing noise situation, and at least every five years after the date of their approval. *Id.* at 4. The plans should also be developed on a cooperative basis when dealing with shared border regions, and should ensure public consultation and participation. *Id.*

111. *See, e.g.*, *Consolidated Statement I*, *supra* note 2, at I-38 (discussing concerns about aviation and idea that aviation's detrimental environmental impacts are both long-standing and vast).

112. *See* CMTY. OF EUR. RY. & INFRASTRUCTURE COS., ET AL., NOISE REDUCTION IN EUROPEAN RAILWAY INFRASTRUCTURE 2-3 (2007) (detailing program to abate railway noise). In 1998, the International Union of Railways (UIC), the Community of European Railways and Infrastructure Companies (CER) and the International Union of Private Wagon Owners (UIP) initiated the "Action Programme for Noise Abatement in Freight Traffic." *Id.* at 4. "The objective of this program is to implement sustainable railway noise abatement measures by introducing low-noise tech-

through the World Forum for the Harmonization of Vehicle Regulations.[113]

V. IMPACT ASSESSMENT, MONITORING, AND MAPPING

The first goal of noise pollution management is to assess the extent to which it exists, obtain clear and robust information on the potential problem and relay this information on to the general public.[114] This goal has a series of overlapping standards involving impact assessment, monitoring and constructing maps that display the noise emissions levels in various locations.[115]

A. Assessment

Impact assessment is a comprehensive process and tool that aims to promote sustainable development. It is used to ensure that human impacts upon the "environment,"[116] arising out of projects, programs and policies, are fully assessed by providing for full disclosure of economic, social and environmental costs before a final decision whether to proceed is made.[117] The United Nations Environment Programme (UNEP) defines Environmental Impact Assessments (EIAs) as "an examination, analysis and assessment of planned activities with a view to ensuring environmentally sound and sustainable development."[118] Parties to the Convention on Bio-

nology in freight traffic, since this traffic represents the main source of railway noise." *Id.*

113. *See* U.N. Econ. & Soc. Council [ECOSOC] Comm'n for Eur., *World Forum for Harmonization of Vehicle Regulations*, Study on Correlation of Stationary and Pass-By Noise Levels and Development of Noise Standards for in-Use Vehicles, U.N. Doc. GRB-41-17 (February 22-24 2005) (*prepared by* S. Raju) (measuring stationary exhaust and engine noise levels of different CMVR categories of noise vehicles).

114. *See* Council Directive 86/594, On Airborne Noise Emitted by Household Appliances, 1986 O.J. (L 344) 24, 24-27 (discussing goals of noise pollution management).

115. *See id.* (discussing standards used in achieving goal).

116. *See id.* (stating environmental impact of noise pollution).

117. *See* Sixth Meeting of the Conference of the Parties to the Convention on Biological Diversity, Apr. 7-19, 2002, 93-94, U.N. Doc UNEP/CBD/COP/6/20, *available at* http://www.cbd.int/doc/decisions/COP-06-dec-en.pdf (describing process of environmental impact assessment).

118. *See* Goals and Principles of Environmental Impact Assessment, U.N.E.P. Res. 14/25 (June 17, 1987), *available at* http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=100&ArticleID=1658 (making recommendations to U.N. General Assembly). See G.A. Res. 42/184, U.N. Doc. A/Res/42/184 (Dec. 11, 1987) (agreeing with findings of U.N.E.P.). *See also* Convention on Environmental Impact Assessment in a Transboundary Context, Feb. 25, 1991, 30 I.L.M. 800 (defining environmental impact assessments). For the purposes of the Convention, commonly referred to as the Espoo Convention, EIAs are defined as "national procedure[s] for evaluating the likely impact of a proposed activity on the environment." *Id.*

logical Diversity (CBD), however, define EIAs as "[a] process of evaluating the likely environmental impacts of a proposed project or development, taking into account inter-related socio-economic, cultural and human health impacts, both beneficial and adverse."[119] Moreover, multiple definitions of EIAs exist in national, regional and international legal instruments. All national laws on this topic can be traced to the United States' National Environmental Policy Act of 1969.[120]

Since the start of the twenty-first century, well over one hundred countries have required EIAs to be used in a variety of ways.[121] For example, noise pollution, depending on quantity, location and timing, can often be considered a significant environmental impact.[122] This act of prediction, prior to reaching a final decision, is both anticipatory and precautionary. Attempts are made to take stock of, and prevent, modify or mitigate, actions with a potential impact before any decisions to proceed are made.[123] These predictions, along with additional considerations of alternatives, mitigation and monitoring options, are presented to both decision-makers and the public at an early stage prior to any decision-making.[124] Accordingly, EIAs require all potential noise pollution im-

119. Sixth Meeting of the Conference of the Parties to the Convention on Biological Diversity, *supra* note 117, at 93 (providing Convention on Biological Diversity definition of environmental impact assessment).

120. *See* National Environmental Policy Act of 1969, Pub. L. No. 91-190, § 2, 83 Stat. 852 (1970) (amended 1975, 1982) (current version at 42 U.S.C. § 4321 *et seq.* (2006)) (detailing history of National Environmental Policy Act of 1969).

121. *See* Meeting of the Parties to the Convention on Environmental Impact Assessment in a Transboundary Context, June 1-4, 2004, Report of the Third Meeting, Dec. III/4: Guidelines on Good Practice, U.N. Doc. ECE/MP.EIA/6 (Sept. 13, 2004), *available at* http://www.unece.org/env/documents/2004/eia/ece.mp.eia.6.e.pdf (making recommendations for nations to Convention in defining national policy). *See also* Meeting of the Parties to the Convention on Environmental Impact Assessment in a Transboundary Context, Feb. 26-27, 2001, Report of the Second Meeting, Dec. II/2: Practical Application of the Convention, U.N. Doc. ECE/MP.EIA/4 (Aug. 7, 2001), *available at* http://www.unece.org/env/documents/2001/eia/ece.mp.eia.4.e.pdf (stating recommendations relating to environmental impact assessments). *See generally* John Glasson et al., Introduction to Environmental Impact Assessment 36-37 (2003) (providing general environmental impact assessment principles); *see also* Joe Weston, Planning and Environmental Impact Assessment in Practice, 3-5 (1999) (outlining Environmental Impact Assessment in various countries which exhibit different degrees of enthusiasm).

122. *See* Gilully, *supra* note 47, at 189-91 (noting significant impacts of noise pollution).

123. *See* Jane Holder, Environmental Assessment: The Regulation of Decision Making 13 (2005) (explaining steps in decision-making process).

124. *See id.* (describing early steps in decision-making process); see also Int'l Ass'n for Impact Assessment [IAIA], Biodiversity in Impact Assessment, Special Publication Series No. 3 (July 2005), *available at* http://www.iaia.org/modx/assets/files/SP3.pdf (citing importance of biodiversity in impact assessment).

pacts resulting from any given project to be disclosed to both the public and decision-makers.[125]

B. Monitoring and Mapping

Monitoring existing sources of noise pollution is the foremost method for providing the public and decision-makers with the information they require. This obligation is already in place in a number of settings, such as high noise areas like airports.[126] Yet, this obligation has proven difficult to implement both internationally[127] and regionally[128] because of changes in scientific knowledge and the lack of harmonized methodologies for monitoring.[129] As a result, international efforts via the International Civil Aviation Organization (ICAO) are underway to produce accessible and transparent noise databases for airports.[130] Such databases will make it possible to compare noise levels between airports, both domestically and internationally.[131] These noise pollution comparisons and analyses will allow authorities, communities and individual citizens to make informed decisions on noise pollution issues.

EU Member States have also adopted this monitoring and mapping approach,[132] but the obligation to monitor and create noise maps has expanded beyond the initial focus upon airports.[133] The mechanism by which this is achieved is known as "strategic

125. *See* Goals and Principles of Environmental Impact Assessment, *supra* note 118 (noting goals and principles of environmental impact assessments).

126. *See* ICAO, Comm. on Aviation Envtl. Prot., Working Paper, *Replacement Of ICAO Circular 205: Recommended Method for Computing Noise Contours Around Airports*, at 2-4, ICAO Doc. CAEP/7-WP/22 (2006), *available at* http://www.tc.gc.ca/civilaviation/International/ICAO/committee/pdf/working/Jan-22-07/CAEP7_WP22.pdf [hereinafter *Replacement of ICAO Circular 205*] (discussing noise around airports).

127. *See id.* (providing guidance for calculating and controlling noise near airports).

128. *See Communication from the Commission to the Council, supra* note 46, at 18-19 (discussing noise monitoring at airports).

129. *See, Commission Green Paper on Future Noise Policy*, at 17-19, COM (1996) 540 final (Apr. 11, 1996) (explaining goal of harmonized methodology).

130. *See* ICAO, *Environmental Technical Manual on the Use of Procedures in the Noise Certification of Aircraft*, ICAO Doc. 9501-AN/929, ch. 6, 2 (3d ed. 2004) (setting up noise database).

131. *See id.* (discussing databases).

132. *See* Council Directive 2002/49, *supra* note 109, at 16 (discussing member states' obligations relating to strategic noise maps).

133. *See generally Commission Green Paper on Future Noise Policy, supra* note 129, at 16 (describing noise reduction measures), *see generally Replacement of ICAO Circular 205, supra* note 126, at 1-4 (discussing noise reduction technologies).

noise maps."[134] Strategic noise maps are built upon harmonized indicators and map emission levels for both day and night.[135] These indicators provide a current noise exposure assessment in specific areas and also predict how they may develop in the future.[136] The maps, therefore, show noise locations, measure noise levels and indicate how many people are exposed to the emissions.[137]

EU Member States must meet specific mapping requirements applicable to all cities with: (1) more than two hundred fifty thousand inhabitants and major roads with more than six million vehicles annually; (2) major railways with more than sixty thousand trains passing per year; and (3) major airports with more than fifty thousand take-offs and landings within their territories.[138] In England, noise maps were available for road, rail and industry in twenty-three large urban areas and eighteen airports by early 2008.[139] These maps must be updated every five years, and the requirements for when such maps must be completed are being progressively lowered.[140] For example, mapping must now be undertaken for major roads carrying greater than three million passengers annually.[141] Additionally, the European Commission must be kept informed of all major road and railway traffic statistics within their territories.[142] Finally, when dealing with strategic noise mapping near borders, EU Member States are expected to be cooperative with bordering countries.[143]

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134. Relating to the Assessment and Management of Environmental Noise, *supra* note 109, at 14 (explaining European approach to noise mapping).

135. *See id.* at 13 (discussing extension of technological measures used in noise reduction).

136. *See id.* at 18-19 (discussing existing assessments and possible future developments shown by noise maps).

137. *See id.* at 15 (describing noise mapping indications).

138. *See id.* (noting limitations and requirements for background noise reduction procedure).

139. *See* Department for Environment, Food and Rural Affairs, Noise Mapping England, http://www.defra.gov.uk/environment/noise/mapping/index.htm (last visited Feb. 24, 2009) (providing information about noise mapping).

140. *See* Relating to the Assessment and Management of Environmental Noise, *supra* note 109, at 16 (explaining expansion in noise maps).

141. *See id.* (providing information to public regarding strategic noise maps).

142. *See id.* at 15-16 (explaining responsibilities of Commission regarding regional noise traffic).

143. *See Environmental Technical Manual on the Use of Procedures in the Noise Certification of Aircraft*, *supra* note 130, at art. 7 (noting responsibilities of member nations of EU).

VI. BASIC INTERNATIONAL LIMITS AND THE ROLE OF TECHNOLOGY

Certain sources of noise pollution are best dealt with through international standards that progressively restrict permissible levels of emissions. This is particularly important where emissions or the sources of emissions are, or have the capacity to become, transboundary.[144]

Road traffic is a major contributor to environmental noise in many areas, particularly urban areas. Although this noise level may be increasing due to the exponential growth in motor vehicles and the presence of older, noisier vehicles, noise emissions of individual vehicles are remarkably lower than in the past.[145] More specifically, noise levels from individual cars have been reduced by eighty-five percent since 1970, and noise from cargo trucks has been reduced by ninety percent.[146] Although voluntary in most instances, technological improvements have occurred because domestic, regional and international standards have reduced the permissible levels of noise emissions.[147]

The best example of this is the European harmonized noise requirements for road vehicles, which follow noise standards from the World Forum for the Harmonization of Vehicle Regulations.[148] Since being introduced in 1970, these frequently amended vehicle standards have set permissible sound levels and exhaust systems for four-wheel motor vehicles and are credited with reducing noise emissions of some vehicles by up to 10 dB(A).[149] Noise emission levels are also set for two and three-wheel motor vehicles.[150] The standards themselves depend on engine size, fuel type, vehicle

144. *See generally Communication from the Commission to the Council, supra* note 46, at 5 (considering effects of noise pollution on European nations).

145. *See id.* at 1 (explaining noise contributions of newer vehicles).

146. *See id.* (citing specific statistics of noise contributions of newer vehicles).

147. *See* 42 U.S.C. § 4917 (2006) (acknowledging original objective of 1972 legislation was that regulations and standards for motor vehicle noise emissions be created).

148. *See* Agreement Concerning the Adoption of Uniform Technical Prescriptions for Wheel Vehicles, Equipment and Parts Which can be Fitted and/or be Used on Wheel Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of These Prescriptions, Mar. 20, 1958 (amended Feb. 3, 2008), E/ECE/TRANS/505 [hereinafter Agreement Concerning the Adoption of Uniform Technical Prescriptions for Wheel Vehicles] (providing noise regulations developed within United Nations Economic Commission for Europe (UNECE)).

149. *See* Council Directive 70/157, pmbl., 1970 O.J. (L 42) 16 (EC) (setting permissible sound limits and sound reduction methods).

150. *See* Council Directive 97/24, 1997 O.J (L 226) 1 (EC) (requiring mandatory technological measures).

weight, and the vehicle's purpose.[151] For example, passenger vehicles with nine or fewer seats, are required to have an emission level at or below 74 dB(A).[152]

In addition, the EU promulgates complementing directives to the United Nations Economic Commission for Europe's standards.[153] These standards provide for both the testing and limitations of tire noise levels and for increased levels of control.[154] The limitations differentiate by both vehicle type and tire width.[155] Furthermore, the limits are progressively strengthened in terms of what noise emission levels are permissible. Future limits on tire types are particularly important, as the sound of wheels on the road currently accounts for the majority of noise made by cars traveling over thirty kilometers per hour.[156] This noise is due to the roughness of road surfaces, which cause tires to vibrate and produce sound waves.[157] These waves are supplemented by air trapped beneath the advancing tire, which creates noise as it is forced out.[158] Redesigning tires may potentially reduce noise emissions by up to fifty percent without compromising safety.[159]

Furthermore, the need to have national noise emissions standards for railway sources, such as those in the United States, or re-

151. *See id.* (noting standards of noise pollution measurement).

152. *See id.* at pmbl. (setting sound level limits for two or three-wheel motor vehicles).

153. *See* Agreement Concerning the Adoption of Uniform Technical Prescriptions for Wheel Vehicles, *supra* note 148, at Regulation 51 (establishing provisions relating to motor vehicle noise). The European Commission is pursuing its efforts at the UNECE level in order to propose the integration of the European tire rolling noise provisions in Regulation No. 51 of the 1958 Agreement of the World Forum for Harmonisation of Vehicles. *Id.* Other contracting parties to Regulation No. 51 are not considering the tire as the only critical parameter, and suggest additional measures to address traffic noise, in particular regarding road surfaces and infrastructures. Forum of European Nat'l Highway Research Labs. [FEHRL], *Final Report SI2.408210 Tyre/Road Noise Vol. 1*, at 91 (2006), *available at* http://ec.europa.eu/enterprise/automotive/projects/report_tyre_road_noise1.pdf [hereinafter FEHRL Final Report].

154. See Council Directive 2001/43, 2001 O.J. (L 211) 25, 25 (explaining directive relating to tires, trailers and fittings); *see also* ECOSOC, Inland Transp. Comm., *Report of the World Forum for Harmonization of Vehicle Regulations*, ¶29-33, U.N. Doc. ECE/TRANS/WP.29/1056 (Dec. 4, 2006) (describing forum discussions that Regulation 51 is not only critical parameter and suggesting additional measures to address traffic noise, road surfaces and infrastructure).

155. *See* Council Directive 2001/43, *supra* note 154, at 25-26 (discussing reasons for limitations on regulations).

156. *See* FEHRL Final Report, *supra* note 153, at 16 (explaining main source of noise from cars traveling over 30km/hr).

157. *See id.* at 5-6 (describing reasons for noise from tires on roadways).

158. *See id.* (explaining how noise is created by air being forced from tires).

159. *See id.* at 84-89 (discussing possible effects of redesigning tires).

gional railway standards, like in Europe, is well recognized, as is the link between technology and reducing such emissions.[160] With regards to inter-operable rail systems, European legislation addresses railway noise at its source through directives on railway inter-operability for high-speed[161] and conventional railways.[162] These directives provide a legislative framework for technical and operational harmonization of the European rail network.[163] Under this legislation, the UNECE has established Technical Specifications for Interoperability (TSIs).[164] TSIs set existing and future noise emission limits, as well as goals for high-speed trains and rolling stock.[165] Although all of these directives are important in controlling noise emissions, the principal source of noise from railways comes from freight wagons fitted with cast iron brake blocks.[166] Whenever a train brakes, these blocks scrape the running surface of the wheel, generating most rail noise.[167] These noise emissions can be remedied by the prevention of wheel surface abrasion through the use of synthetic brake blocks.[168] Such a measure can reduce noise emissions by up to 10 dB(A), and is cost-neutral when building wagons.[169] In 2003, the International Union of Railways approved the use of synthetic break blocks in international traffic for specific types of wagons; since that time, all new railway wagons in Europe have been fitted with the new technology.[170]

160. *See, e.g.*, 42 U.S.C. § 4916 (2006) (establishing railroad noise emission standards).

161. *See* Council Directive 96/48, annex III, 1996 O.J. (L 235) 22 (EC)_ (evidencing European concern for noise pollution). It should be noted that the noise level generated by the trans-European high-speed rail system is meant to be acceptable for its surroundings and to be kept within limits suitable to protect neighboring populations and their activities. *Id.* Noise levels along new or upgraded infrastructures must not exceed the noise levels defined by national rules, which take into account the noise emission characteristics of the interoperable trains. *Id. See also* Council Directive 2001/16, annex III, 2001 O.J. (L 110) 16 (requiring conventional rail systems to respect noise pollution regulations).

162. *See* Council Directive 2001/16, *supra* note 161, annex III (requiring conventional rail systems to respect noise pollution regulations).

163. *See generally id.* (providing overview of railway regulations).

164. *See* Council Directive 2002/735, annex, O.J. (L 235) 405 (defining TSIs for rolling rock subsystem); *see also* Council Directive 2002/732, annex, 2002 O.J. (L 245) 146 (EC) (defining TSIs for high-speed rail system).

165. *See* Council Directive 2002/735, *supra* note 164, at annex (discussing setting emission limits).

166. *See* NOISE REDUCTION IN EUROPEAN RAILWAY INFRASTRUCTURE, *supra* note 112, at 2 (explaining controlling emissions).

167. *See id.* (explaining noise generated from trains).

168. *See id.* (explaining how noise emissions can be remedied).

169. *See id.* at 20 (examining solutions for noise emissions).

170. *See id.* at 4-5 (citing freight wagons as noise producers and synthetic brake blocks as remedies).

Civil aviation is the final example of the reduction of international noise emissions through changing technologies and standards. Lately, improvements in design and technology have been impressive.[171] Aircrafts produced in 2007 are approximately seventy-five percent quieter than they were forty years earlier.[172] Moreover, further progress will be achieved by the combination of developments in engine source noise, nacelle technology, airframe-generated noise, installation effects and low noise flight operational procedures.[173]

In addition, aircraft manufacturers expect to deliver even greater reductions in the future. The B797 Boeing Dreamliner aircraft, for example, is expected to deliver noise reductions of approximately 15 to 20 dB(A) below the current limits, which are at least 10 dB(A) better than the older aircrafts it will replace.[174] On the whole, improved design and technology may reduce aircraft noise by up to three thousand times that of currently operating aircraft.[175]

Technological improvement in this field has a direct relationship to the ICAO Standards and recommended practices for aircraft and helicopter noise certification. Noise pollution problems caused by aircraft sonic booms were dealt with through commercial considerations before the need for regulation arose.[176] In most situations, technological standards, often supplemented by supporting regional pressures, are clearly linked to improvements in noise

171. *See* ICAO, *Environmental Report*, at 130 (2007), *available at* http://www.icao.int/env/pubs/Env_Report_07.pdf [hereinafter ICAO Environmental Report] (detailing improvements in design and technology).

172. *See id.* (explaining differences in aircraft from forty years earlier compared to 2007).

173. *See id.* at 24 (explaining efforts at reducing noise pollution from aircrafts)

174. *See id.* (reporting on aviation industry's current efforts in environmental protection).

175. *See* Clive Cookson, *"Silent Aircraft" Starts to Spread Wings*, FIN. TIMES, Nov. 6, 2006 (discussing possibility of noise reduction from futuristic planes).

176. *See Consolidated Statement I, supra* note 2, app. G (detailing assembly resolutions regarding sonic boom problem). This resolution seeks to ensure that supersonic aircrafts do not create "unacceptable situations for the public due to sonic boom, such as interference with sleep and injurious effects to persons and property on land and at sea". *Id.* Accordingly, the ICAO "reaffirms the importance it attaches to ensuring that no unacceptable situation for the public is created by sonic boom from supersonic aircraft in commercial service." *Id.* The problem self-rectified, however, when the last commercial supersonic aircrafts, such as the Concorde, were voluntarily removed from service in 2003. *See generally* CHRISTOPHER ORLEBAR, THE CONCORDE STORY (2004) (discussing removal from service).

control.[177] As a result of the environmental benefits of such standards and the fact that ICAO implemented them internationally, these standards have introduced a level playing field applicable to all interested parties.[178]

The ICAO standards were first published in 1971 pursuant to the provisions of Article 37 of the Chicago Convention on International Civil Aviation.[179] The ICAO standards have been continually updated since then, and have progressively expanded in scope. The first generation of jet-powered airplanes covered under Chapter 1, including the Boeing 707 and the Douglas DC-8, were not covered by ICAO standards.[180] Yet, those aircraft built after 1977, such as the Boeing 737 and the Airbus 319, covered under Chapter 3, had to comply with the new standards.[181] These standards promised a twenty-five year utilization period for the aircraft before a mandatory phase-out.[182] By mid-2002, Chapter 2 aircraft, which have been progressively phased out since 1995, were no longer permitted to operate in many regions,[183] and ninety-seven percent of Chapter 2 aircraft had been removed from service by 2007.[184] Importantly, the standards have substantially reduced noise levels at many airports.[185]

The ICAO has continued to develop standards and timetables for newer aircraft as well. These standards and timetables have included Chapter 3 aircraft, such as the Boeing 737-300/400, Boeing

177. *See Report from the Commissioner to the European Parliament and the Council Concerning Existing Community Measures Relating to Sources of Environmental Noise*, at 11-13, COM (2004) 160 final (Oct. 3, 2004) (describing measures taken to decrease aircraft noise). In 1998 the European Commission proposed a new directive aimed at limiting the operation in the European Union of Chapter 2 aircraft fitted with "hushkits," which are a type of noise muffling technology. *Id.* The European Commission repealed the ensuing regulation in 2002 "following the adoption of new Directive 2002/30/EC, which enshrined the ICAO Resolution A33-7 on the use of a *'balanced approach'* to noise management around airports." *Id.*

178. *See id.* at 13 (explaining introduction of standards internationally).

179. *See* ICAO, *Convention on International Civil Aviation*, art. 37, ICAO Doc. 7300 (1st ed. Dec. 7, 1944) (establishing framework for international aviation standards to be created and updated periodically); *see also id.* annexes 1-18 (summarizing development of additional environmental standards in Annex 16).

180. *See ICAO, Convention on International Aviation*, at 8, ICAO Doc. 7300/8 (8th ed. 2000) (discussing engines covered by ICAO standards).

181. *See id.* (explaining aircraft built after 1977 need to comply with ICAO standards).

182. *See id.* at 8-9 (promising twenty-five year period of use before phasing out).

183. *See* ICAO Environmental Report, *supra* note 171, at 50 (outlining history of airport operating procedures to reduce noise pollution).

184. *See id.* (explaining removals of aircraft from service).

185. *See id.* at 49-50 (discussing noise reduction without Chapter 2 aircrafts).

767 and Airbus A319, which led to ICAO approval of Chapter 4 standards in 2001.[186] The new standards for Chapter 4 aircraft became applicable in 2006 not only to newly certified airplanes, but also to Chapter 3 aircraft for which re-certification under Chapter4 was requested.[187] Yet, as always, the technology restrictions were meant as part of an overall response. Thus, in the case of Chapter 3 aircraft, the ICAO Assembly urged states not to introduce any operating restrictions at any airport on Chapter 3 aircraft before fully assessing other available measures to address noise pollution.[188] The ICAO Assembly also listed a number of safeguards based on the noise performance of airplanes which would need to be met if restrictions were to be imposed on Chapter 3 aircraft.[189] Furthermore, special attention should be paid to the circumstances of the operators from developing countries.[190]

VII. The Limits of Technological Change

Although technology can lead to remarkable improvements in the reduction of emissions from individual sources of noise, it is important to realize that the overall problem will not be solved with an isolationist approach. Instead, new standards must be reconciled with the consideration of two further factors. First, as improved and quieter vehicles are introduced into the marketplace, older and noisier vehicles must be removed or phased out. Failure to phase out old transportation vehicles may counteract any benefits derived from the improvements. For example, unless the existing fleet of approximately six-hundred thousand older, noisier rail wagons are refitted or phased out, the railway wagons with improved noise reducing technologies will have a minimal impact on reductions in overall noise pollution.[191] The same conclusion applies for motor vehicles; unless older vehicles are retired, the savings created by the best modern technologies may be nullified.[192]

186. *See Environmental Technical Manual on the Use of Procedures in Noise Certification Aircraft, supra* note 130, at A8-1 (explaining developing standards for aircraft).

187. *See id.* (discussing recertification criteria); *see also* ICAO Environmental Report, *supra* note 171, at 22 (providing overview of certification criteria).

188. *See Consolidated Statement I, supra* note 2, app. D (describing phase-out of subsonic jet aircraft which exceed noise levels in Volume I of Annex 16).

189. *See id.* (listing noise pollution restrictions for Chapter 3 aircraft).

190. *See id.* (describing noise restrictions).

191. *See* Peter Hübner, Int'l Union of Rwys., Status Report and Background Information on Noise-Related Track Access Charges, 3 (2007) (providing railways could not absorb cost of retrofitting 600,000 older freight wagons).

192. *See* Ruth Greenspan Bell et al., *Cleaning the Air: How Delhi Broke the Logjam on Air Quality Reforms*, Env't, Apr. 2004, at 22, 27 (noting challenges to limiting vehicle pollution); *see also* Tara Patel, *India's Rickshaws Clean Up Their Act*, New Sci-

Second, unless there are constraints on the overall rate of growth on individual sources of noise pollution, the exponential growth or increased intensity of output for emitters may eclipse the savings of technological improvements. For example, even though noise-reducing measures may be incorporated in the design of machinery, greater output may generate higher noise levels. For instance, each time the speed of a rotary machine is doubled, the noise output increases by approximately 7 dB(A), although this may be greater for certain individual machines.[193] A different variation of this problem is particularly notable with regards to motor vehicles. Although noise limits have tightened over the years, no improvements have been made regarding overall exposure to noise generated by motor vehicles because of significant increases in road traffic.[194]

A final example of greater noise pollution based on increased use can be seen with commercial aircraft. In particular, between 1990 and 2015, global passenger air travel is projected to grow by approximately five percent per year.[195] Unless reductions in noise pollution are greater than this annual increase, supplemented by actual reductions from the existing fleet, the problem will not improve.[196] As such, technological changes implemented by continuous fleet renewal, if unaccompanied by other measures, will not necessarily be sufficient to reduce the problem of noise pollution.[197]

VIII. Basic Domestic Limits and the Omission of Standards

To avoid acute mechanical damage to the inner ear, adults should never be exposed to more than 140 dB(A) of noise, even for very short periods; for children, the noise threshold level is 120 dB(A).[198] Therefore, to make enforcement of noise pollution con-

ENTIST, Feb. 15, 1997, at 7 (commenting most current rickshaw drivers cannot afford equipping older rickshaws with new, environment friendly, propane tanks).

193. *See* Kameswaran, *supra* note 60, at 55 (explaining changes in noise pollution at varying speeds).

194. *See* Steven E. Plotkin, *The Road to Fuel Efficiency in the Passenger Vehicle Fleet*, ENV'T, July-Aug. 1989, at 18, 22 (stating light truck sales are rising relative to autosales).

195. *See* Intergovernmental Panel on Climate Change, *Aviation and the Global Atmosphere*, at 4 (1999) (projecting future air travel growth).

196. *See id.* (explaining effects of aircraft on increase in Greenhouse gases).

197. *See Communication from the Commission to the Council*, *supra* note 46, at 2 (providing economic and regulatory incentives should be made among Europe's air transport system).

198. *See generally* B. Griefahn et al., *Protection Goals for Residents in the Vicinity of Airports*, NOISE & HEALTH, July-Sept. 2004, 51, 51-62 (holding noise levels at or

trols easier, it would be useful to have such standards recognized in international law, as opposed to only soft international guidelines. When such noise pollution is experienced only domestically, however, meaningful basic limits enacted in accordance with international benchmarks are near impossible to find.

The best example of a lack of meaningful international regulatory standards is industrial noise, which is the most common and irreversible, yet the most preventable, form of noise pollution.[199] Unlike other forms of noise pollution, industrial noise, which is traditionally associated with heavy machinery, is typically viewed from the perspective of a health and safety concern for workers rather than as a pollutant or distinctive type of nuisance.[200] Accordingly, international emphasis on this topic comes from the International Labor Organization (ILO) rather than from international bodies like the WHO.[201] Although the WHO has recommended limits for noise pollution for workers,[202] the WHO recommendations have not been adopted by the ILO. Rather, the ILO's position stems from its 1977 Convention Concerning the Protection of Workers against Occupational Hazards in the Working Environment Due to Air Pollution, Noise and Vibration.[203] Yet, the Convention only addressed general goals and recommended both preventative and protective measures, including personal protective equipment, which were to be buttressed by national laws and regulations.[204] It did not recommend overall standards for emissions of noise pollution.[205] This approach is consistent with the ILO Code of Practice

exceeding 120 dB(A) cause damage to children's inner ear); *see also* GUIDELINES FOR COMMUNITY NOISE, *supra* note 13, at viii (explaining adverse health effects of noise).

199. *See* GUIDELINES FOR COMMUNITY NOISE, *supra* note 13, at xvi (discussing industrial noise and its problems).

200. *See* Kameswaran, *supra* note 60, at 54 (stating focus of industrial noise research).

201. *See generally* Convention Concerning the Protection of Workers Against Occupational Hazards in the Working Environment Due to Air Pollution, Noise and Vibration, June 20, 1977, 1 S.M.T.E. 482 (detailing international hazards found by ILO).

202. *See* GUIDELINES FOR COMMUNITY NOISE, *supra* note 13, at viii (stating appropriate exposure levels). Exposure to sound for more than eight hours per day should not exceed 85 dB, or 70 dB(A) if based over a twenty-four hour period. *Id.*

203. *See generally* Convention Concerning the Protection of Workers Against Occupational Hazards in the Working Environment Due to Air Pollution, Noise and Vibration, *supra* note 201 (noting measures taken to reduce air pollution, noise and vibration in workplace).

204. *See id.* arts. 4, 10, 16 (identifying Convention's addressing generalized goals).

205. *See id.* arts. 7-12 (noting Convention has goal of, as far as possible, keeping working environment free from any hazard due to noise pollution).

for those who work in especially noisy industries, such as shipping.[206]

Another example of how sections of the international community have avoided setting robust and basic industrial noise limits can be seen within the European Community. In the EC, noise is an environmental issue Member States must consider when issuing permits to operators of large industrial and agricultural installations that are covered by the Integrated Pollution Prevention and Control (IPPC) Directive.[207] Although a certain degree of flexibility is permissible in some areas, the IPPC Directive aims to minimize pollution from fifty-two thousand industrial sources throughout the European Union.[208] This flexibility allows the licensing authorities, in determining permit conditions, to take into account: (1) the technical characteristics of the installation; (2) its geographical location; and (3) local environmental conditions.[209] Although noise issues are dealt with in IPPC documents, there is no requirement that industrial machines be designed and constructed to minimize noise emissions.[210] Furthermore, because IPPC permits do not require declarations of the industrial machine's noise emissions, no requirements can be set as to the best available technology for noise prevention and control.[211]

This hands-off approach is due to the fact that industrial noise is recognized as a local, as opposed to a national, environmental issue, and measures are to be taken at a specific installation based on its regional location.[212] Accordingly, although most EC Member

206. *See* Int'l Labor Org. [ILO], General Conference of the Int'l Labor Org., Geneva, Switz., Oct. 14, 1970, *Crew Accommodation, Noise Control Recommendation* (1970), *available at* http://www-old.itcilo.org/actrav/actrav-english/telearn/osh/legis/r141.htm (showing recommendation called for research into problem of noise pollution, and adoption of measures to reduce and control noise pollution in work environments from sound proofing to location of noise sources and ear protection for workers).

207. *See* Council Directive 2008/1, art. 1, 2008 O.J. (L 24) 8, 10-11 (EC) (explaining operators of industrial installations covered by Annex I of IPPC Directive are required to obtain authorization from authorities in EU countries). All existing installations covered by Directive had to comply with permit conditions based on basis of best available techniques by end of 2007. *Id.* at 9. IPPC Directive is based on several principles, namely (1) integrated approach, (2) best available techniques, (3) public participation and flexibility. *Id.* at 9-10.

208. *See id.* arts. 2, 6, 8 (discussing goal of minimizing industrial pollution from 52,000 industrial sources).

209. *See generally id.* (noting lack of requirements regarding noise).

210. *See generally id.* (stating lack of regulation for industrial machines).

211. *See generally id.* (stating lack of regulation for industrial machines).

212. *See* European Commission, http://ec.europa.eu/environment/air/pollutants/stationary/ipcc/index.htm (last visited Aug. 24, 2008) (recognizing industrial noise as regional issue).

States have very similar limits in this area,[213] each country has been free to set its own standards for industrial noise emissions. This problem may become increasingly worse if countries decide not to specifically address industrial noise emissions. In the United Kingdom, for example, there are recommended maximum exposure levels for noise but no specific industrial noise limits.[214] Even if industrial noise emissions run afoul of common law nuisance precedents, the only guidance on the topic comes from the Town and Country Planning Act of 1990 (The Act). Recent revisions, outlined in the Town and Country Planning Order of 2005, provide general guidance and advice on planning considerations for new developments where domestic dwellings may be subject to noise.[215]

Additionally, just like the problems associated with localized industrial noise regulations, regional and national standards for noise pollution are also hard to find. Yet, some examples nevertheless exist, such as European limits on fifty-seven types of equipment for outdoor use, including lawn-mowers,[216] tractors,[217] and certain types of recreational crafts like motorboats.[218] In most other domestic instances, however, overall standards are remarkably difficult to locate. Countries instead tend to confront non-international and non-industrial noise problems via a combination of the laws of nuisance and codes of practice. Thus, in the United Kingdom, codes of practice have been developed for a variety of lesser sources of noise under the 1974 Control of Pollution Act,[219] including audible

213. *See* European Commission, Noise, http://ec.europa.eu/environment/noise/greenpap.htm (last visited Feb. 25, 2009) (showing specific limits implored by EC countries on industrial noise).

214. *See Commission Green Paper on Future Noise Policy, supra* note 129, at 4 (discussing lack of legislation in any community regarding industrial noise).

215. *See generally* Explanatory Memorandum to Town and Country Planning (Blight Provisions) (England) Order 2005, 2005 No.406, 7.4 (U.K.) (providing general guidance and advice on planning considerations for new developments).

216. *See* Council Directive 2000/14, pmbl., 2000 O.J. (L 162) 1, 2 (EC) (showing concern regarding noise emission from lawnmowers).

217. *See* Council Directive 74/151, annex VI, 1974 O.J. (L 84) 25 (EC) (showing limits for noise emission of tractors).

218. *See* Council Directive 2003/44, annex 1, 2003 O.J. (L 214) 18, 24-29 (EC) (stating noise emission limits set for recreational boats).

219. *See* Control of Pollution Act, 1974, c.40, §71 (Eng.) (setting codes of practice in United Kingdom). The Code of Practice is meant to minimize noise disturbance and must be inclusive, reasonable, appropriate to the circumstances, represent good current practice, and take all relevant interests into account. *Id.*

intruder alarms,[220] model aircraft[221] and even ice cream van chimes.[222]

This problem becomes even greater when dealing with consenting adults who voluntarily endure noise pollution. For example, when dealing with devices such as personal music players with headphones, maximum volume levels should not be allowed above 110 dB(A) to avoid acute hearing impairment. Moreover, the equivalent sound level over twenty-four hours should not exceed 70 dB(A), and for a daily one hour exposure the level should not exceed 85 dB(A).[223] In a similar vein, music concerts should not exceed 100 dB(A) for a four hour period, and people should not be exposed to such levels more than four times per year to avoid hearing damage.[224]

Therefore, to avoid acute hearing impairment, noise pollution should always be below 110 dB(A).[225] While there is a strong case for standards and regulations which would make such devices technologically compliant and a strong case for concerts to adhere to certain sound limits for young people or non-consenting adults, the case is much more difficult with regards to consenting adults. Some regions, such as Europe, have attempted to set absolute noise limits with consumables such as household appliances.[226] The better approach for adults who voluntarily seek high levels of noise only impacting themselves is an approach in which warning labels are attached to each item, which fully informs the consumer of the noise levels emitted by the item. The importance of such labeling has been acknowledged in both the United States[227] and Europe,[228] but has been slow to develop as a standard. Some parts of Europe

220. *See* RUPERT TAYLOR, DEPARTMENT FOR ENVIRONMENT, FOOD & RURAL AFFAIRS, REVIEW OF EXISTING CODES OF PRACTICE ON MINIMISING NOISE, 2 (2005) (reviewing approved Code of Practice on noise for audible intruder alarms).

221. *See id.* (reviewing approved Code of Practice relating to noise from model aircraft).

222. *See id.* (reviewing approved Code of Practice on noise from ice cream van chimes).

223. *See* GUIDELINES FOR COMMUNITY NOISE, *supra* note 13, at xiv (discussing noise guidelines for headphones).

224. *See id.* at xv (highlighting noise recommendations for concerts and like events).

225. *See id.* at xiv (recommending noise level to avoid acute impairment).

226. *See* Council Directive 86/594, *supra* note 114, at 24-27 (setting fundamental parameters for noise emitted by household appliances).

227. *See* 42 U.S.C. § 4907(a) (2006) (requiring regulations to designate products which emit noise capable of adversely affecting public health).

228. *See* Council Directive 2000/14, *supra* note 216, at 6 (requiring marks of conformity for outdoor equipment on market which complies with guaranteed sound power levels).

require warning labels to be visible, legible and indelibly affixed to each item of sound equipment, and disclose the noise levels that may be emitted.[229]

IX. QUIET ZONES

Quiet zones, areas requiring noise levels which are much lower than normal, contain vulnerable subgroups: people with particular medical conditions or biological characteristics, such as young, old, sick or disabled persons, which make them vulnerable to noise pollution.[230] Areas which contain vulnerable subgroups should maintain noise levels within strict boundaries. The WHO guidelines for hospital areas are between 30 dB(A) and 40 dB(A), depending on the time of day and the location of the hospital.[231] If the goal is to protect patients with a susceptibility to stress, noise levels should not exceed 35 dB(A), especially in critical areas, such as intensive care units, operating theatres and newborn areas.[232]

Other zones where noise levels need to be controlled include places of learning, such as schools, where students engage in enhanced cognitive activities, or other areas where people are trying to understand complicated information. Given that speech comprehension and communication are important in learning situations, background noise levels should not exceed 35 dB(A) during teaching sessions.[233] For hearing impaired children, lower sound levels may be required.[234]

Noise limits also need to be controlled around domestic areas. If the goal is to avoid sleep disturbance, annoyance and speech interference, a series of noise limits are required. In order to avoid sleep disturbances from noise pollution, the indoor guideline value for bedrooms is 30 dB(A).[235] At night, outside sound levels close to the façades of living spaces should not exceed 45 dB(A).[236] To enable casual conversation indoors during the day, the sound level of

229. *See id.* at 2 (describing markings for equipment regarding noise).

230. *See* GUIDELINES FOR COMMUNITY NOISE, *supra* note 13, at xiv (highlighting importance of sound levels with children and sick).

231. *See id.* (discussing noise guidelines for hospitals, ward rooms and indoors).

232. *See id.* (addressing noise-related concerns with specific types of patients in hospitals).

233. *See id.* (addressing concerns for hearing impaired and classroom).

234. *See* GUIDELINES FOR COMMUNITY NOISE, *supra* note 13, at 43 (discussing effects of noise on children while in school and recommending maximum sound levels).

235. *See id.* at xiv (addressing decibel levels in bedrooms).

236. *See id.* (discussing noise levels for sleeping).

interfering noise should not exceed 35 dB(A).[237] Moreover, to protect the majority of people from being moderately annoyed during the daytime, the outdoor sound level should not exceed 50 dB(A).[238] Finally, protected areas and conservation areas should be shielded from undue noise pollution or their conservation objectives may be thwarted.[239]

To achieve quiet zones, a combination of policies must be enacted. First, it is necessary to plan land use; failure to properly plan land use can lead to later problems when balancing valid interests of different stakeholders. Thus, locales that require quiet zones should not be situated near places which create undue noise. For example, when dealing with airports, it is important to ensure that the gains achieved by the reduced noise of the latest generation of aircraft are not undermined by further residential development in close proximity to the airports.[240] The ICAO has urged states to locate new airports, runways and routes in appropriate areas away from noise-sensitive regions.[241] Community planners should use a comprehensive approach, ensuring that certain noise levels are compatible with community goals.

In some instances, the solution may be to actually prevent certain noise emitting activities from passing through, or over, the quiet zone. For instance, the National Park Service is considering restrictions on flyovers to prevent the impacts of noise pollution on park species.[242] International agencies have taken a similar approach to protect the integrity of global conservation efforts by providing recommendations for individual countries to prohibit certain noise generating activities in specific areas.[243]

If complete prohibitions on certain noise levels are not achievable, then reductions may be made through either changing the ways that noise emissions are made, or by enacting partial restric-

237. *See id.* (mentioning levels of interfering noise).

238. *See id.* (highlighting levels of outside noise during daytime).

239. *See* GUIDELINES FOR COMMUNITY NOISE, *supra* note 13, at 63 (discussing importance of protecting conservation areas from noise pollution).

240. *See Convention on International Civil Aviation*, *supra* note 179, at 16 (making recommendations for assessment of noise and methods of land use planning around airports).

241. *See Consolidated Statement I*, *supra* note 2, at I-40 (encouraging states to limit encroachment of incompatible development into noise-sensitive areas).

242. *See* 16 U.S.C. § 1a-1 (2006) (establishing national park system of United States); *see also* 16 U.S.C. § 228g (2006) (setting out procedures for regulating aircraft in Grand Canyon).

243. *See generally* ALEXANDER GILLESPIE, PROTECTED AREAS AND INTERNATIONAL LAW (2007) (noting recommendations of international agencies for prohibition of certain noise generation).

tions. It is often possible to reduce airplane noise levels by changing the way machinery is used.[244] With departure procedures, maximum thrusts cannot be conducted below a certain height above the run-way.[245] Such regulations are further supplemented by a collection of other possible restrictions that range from engine power reductions to flap retraction practices.[246] Yet, the appropriateness of any of these measures depends upon the safety of the aircraft and the physical lay-out of the airport and its surroundings.[247] If changes in operational policies do not bring about the required level of reduced emissions, partial prohibitions of noise emissions at specific times may solve the problem. A good example of partial prohibition is the necessity to control aircraft noise at night,[248] where the banning of flights between certain hours can bring near complete reductions in noise pollution.[249]

Nevertheless, if noise levels are part of an already accepted pattern, and it is not possible to reduce them through technology or direct action, then adaptation measures may be necessary. Although many adaptation measures are more expensive to implement than actually reducing the source of the noise, the impacts of noise pollution can be lowered by the concurrent use of several adaptation options, including: (1) building codes; (2) noise insulation barriers; (3) noise-control enclosures; (4) absorbers; (5) silencers; and (6) personal protective equipment, including earplugs.[250] Where necessary, land acquisition and relocation can also be undertaken as an adaptation option.

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244. *See Communication from the Commission to the Council*, *supra* note 46, at 24-26 (discussing research and development requirements and procedures).

245. *See id.* at 8 (discussing changing requirements of airlines to address noise pollution).

246. *See id.* (addressing means aircrafts can use to reduce noise pollution).

247. *See generally* ICAO, *Aircraft Operations: Procedures for Air Navigation Services, Volume I Flight Procedures*, ICAO Doc. 8168-OPS/611 (5th ed. 2006) (outlining aircraft operation procedures).

248. *See* R. Hoeger, *Aircraft Noise and Times of Day: Possibilities of Redistributing and Influencing Noise Exposure*, NOISE & HEALTH, Jan.-Mar. 2004, at 55, 55 (discussing disturbing effects of aircraft noise in relation to time of day sources emerge); *see also* M. Basner & A. Samel, *Nocturnal Aircraft Noise Effects*, NOISE & HEALTH, Jan.-Mar. 2004, at 83, 83 (discussing noise protection associated with construction and extension of airports in Germany).

249. *See* Hoeger, *supra* note 248, at 55 (describing human sensitivity to noise during night and possible benefit of rescheduling air traffic to daytime).

250. *See* HÜBNER, *supra* note 191, at 3 (explaining costs of retrofitting can be large). In Europe, the cost of updating 600,000 older freight wagons, which have a long lifetime, would be between 1,000 and 5,000 Euro for synthetic brake conversion per wagon, aggregating between €1 and €3 billion for the whole fleet. *Id.*

Furthermore, it is often easier to allow individuals or communities to adapt to noise pollution, rather than reduce the direct source of the noise pollution.[251] European railways have implemented various noise insulation programs, and nearly all European countries require noise protection measures when building new railway lines or upgrading existing lines.[252] The traditional method of confronting noise pollution associated with railway construction has been through adaptation measures such as building requirements and noise barriers.[253]

In Scandinavia, protection from railway noise is achieved by insulating buildings, whereas in Italy, noise barriers are the preferred method.[254] By 2005, there were approximately one thousand kilometers of noise barriers in place and about sixty thousand noise-insulated houses or residences in Europe, most of which were fitted with noise-insulated windows in the vicinity of existing railway lines.[255] Although these adaptation measures have not abated all noise pollution from railways, an estimated 1,250,000 people have nevertheless benefited from the adoption of such measures.[256]

X. CONCLUSION

There is no simple solution that can be used to solve all of the problems associated with noise pollution. In large part, this difficulty is due to the nature of the problem. Noise is part of modern life, and it is often desirable to some people either in itself, such as with music, or for the benefits it may bring, such as with aviation. Most people accept that it is necessary to manage and control noise problems, but only when necessary.

Accordingly, the question becomes: when is it necessary to manage noise pollution and how can governments create effective noise pollution control regimes? This question is difficult to answer, as there is no simple solution that can be applied to all situations of noise pollution. Rather, a package of options needs to be brought into play and a "balanced" approach must be adopted.

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251. *See* C.J. Manning, *Noise Control in the Transportation Corridor*, NOISE & HEALTH, Jan.-Mar. 2003, at 43, 43 (offering suggestions regarding mitigating and absorbing noise in highways and railways).

252. *See* NOISE REDUCTION IN EUROPEAN RAILWAY INFRASTRUCTURE, *supra* note 112, at 6 (discussing noise pollution regulations for European railway).

253. *See id.* (discussing means of addressing noise pollution issues).

254. *See id.* at 9-11, 35 (addressing different noise abatement measures).

255. *See id.* at 36 (reporting number of noise barriers in European Union).

256. *See* HÜBNER, *supra* note 172, at 3-4 (representing people who benefit statistically from railway noise protection).

In the vast majority of situations, a balanced approach is necessary because it is impractical to ban all forms of anthropogenic noise. This is not only because the modern world is full of noise, but because much of the noise generating activities deliver benefits to society that are very important. The tension between noise abatement and the benefits of noise generating activity is particularly recognizable at the international level, where debates about banning all forms of aircraft noise, and with it, all forms of air travel, are pure fantasy. Thus, the question is not about banning certain noise emitting sources outright, but finding a balanced approach where noise levels are more heavily regulated in some places, but not necessarily in others. Likewise, at the domestic level, each country has adopted standards on noise pollution that reflect its own goals. More often than not, the management of noise pollution is about balancing legitimate, but competing, interests within local communities.

Due to such competing objectives, both between countries and within individual communities, a number of steps should be undertaken to manage noise pollution. The first step is to ensure that the public is provided with robust and harmonized information on noise emissions. This step can be accomplished via impact assessments for new projects, and information relating to existing sources of noise, such as where, when and how much noise is being produced. The provision of such information should cover noise maps at the regional and local level, directly down to the consumer, through correctly labeled product information, so that each citizen is fully informed when making decisions involving emissions of noise which impact them.

The second step is to recognize that some sources of noise pollution are best dealt with internationally, via standards that progressively define permissible levels of noise emissions. This is particularly important where the emissions are trans-boundary, or where the sources of the emissions, such as cars, trains or planes, are, or can become, trans-boundary. In each of these areas, the international community has begun to confront noise pollution and has, through ever-increasing technological standards, lowered the levels of noise pollution that individual sources generate.

Although such technological progress is commendable, it is important to recognize that without additional policies that manage the allowable noise from such sources, these technological savings may be eclipsed. Despite this caveat, the willingness to set absolute

noise limits for a number of trans-boundary sources should nevertheless be applauded.

Absolute noise limits also stand in direct contrast to the unwillingness of the international community to set limits in terms of what individuals or communities should be exposed to. Such decisions are believed to fall strictly within the confines of sovereign governments, and even the noisiest areas, such as industrial areas, operate without international or regional limits. This omission of overall international standards that should be applicable to all people is regrettable.

The third step, which deals with the recognition that control of the vast majority of noise pollution will be in domestic settings, suggests a starting point for determining where the "quiet zones" should be located in any given community or country. Once these zones are established, they should be protected by land-use planning and, where necessary, adaptation measures. Such planning and measures need to be buttressed by existing laws and action plans on noise pollution, which are committed to reducing such pollution. Once the areas that are most sensitive to noise are adequately protected, it will then be possible to decide the best methods to protect them.