# The Value of Environmental Health Services

## Exploring the Evidence

Environmental Public Health Action Saves Lives, Saves Money and Saves the Future

National Environmental Health Partnership Council, 2016

# The Value of Environmental Health

As a core public health discipline, environmental health interventions fundamentally focus on preventing disease and creating healthy, supportive environments. In 2006, the importance of exploring the value of environmental health services was acknowledged with the report, *Environmental Health Practitioners Developing Strategic Partnerships and Engaging Public Health Policymakers*. This project builds on recommendations presented in this early report (National Center for Environmental Health, 2006).

This document was born out of early discussions of the National Environmental Health Partnership Council (NEHPC) as a potential component of a larger strategy for expanding and sustaining awareness of environmental health problems and programs. A number of individuals who participate in NEHPC offer this completed document with their endorsement. It provides an overview of the literature on the methods for economic evaluation of environmental health interventions.

Studies exploring regulatory and policy economic evaluations conducted by local and state health departments were excluded from this report (e.g., Clean Air Act) but will be a focus of a report in phase two of this project. There have been impressive ROI findings from these studies.

The search of readily available literature yielded 79 peer-reviewed articles: 22 cost/burden of disease, 40 cost-benefit/cost-effectiveness, six on methodology, and 11 return on investment, or ROI. Grey literature was explored and yielded a total of 38 reports from a variety of websites. While not an exhaustive review, the review yielded a number of important findings.

Environmental public health program areas that were explored: (1) food safety; (2) water quality; (3) lead exposures; (4) mercury exposures; (5) climate change; (6) housing; and (7) special populations including children and environmental justice communities.

More information on the impact on public health and the economic impacts can be found in the several reports, including reports to Congress issued by the U.S. Environmental Protection (http://www.epa.gov/air/sect812/prospective2.html).

# Key Findings

- For every $1 invested in lead paint hazard control, a return of investment of $12–$155/household or a net savings of $124–188 billion was realized (Gould, 2009).
- Higher local health department spending on food safety and facility sanitation activities was related to a lower incidence of restaurant related foodborne illness in Washington and a lower incidence of facility inspection-related waterborne disease in New York (Bekemeier et al., 2014).
- An updated analysis of the costs associated with four major categories of chronic childhood conditions – lead poisoning and methylmercury exposure, childhood cancer, developmental disabilities, and asthma – totaled $76.6 billion (in 2008) (Trasande and Liu, 2011).
- Mercury-related losses of cognitive function in children and decreased economic productivity resulted from diminished intelligence over a lifetime. This resulted in an aggregate economic cost in each annual birth cohort of $8.7 billion (Trasande et al., 2006).
- Evidence suggests that urban development strategies and reduction of pollution exposure from roadways would significantly cut health care spending, particularly in low-income neighborhoods (Perez et al., 2012).
- Costs of climate change have been slow to emerge in the research literature. Ebi et al. (2004) reported that the cost of running a heat–health warning system for Philadelphia was relatively small (USD $210,000) compared with the benefits of saving lives (USD $468 million) from 1995–1998.
- The National Asthma Control Program's return on investment is compelling: for every dollar spent on national and state-level programs, $71 in asthma-related expenditures is saved (CDC, 2013).

**There are a number of challenges in valuing environmental health interventions:**

- The benefits of environmental health interventions are hard to measure.
    - Estimating benefits requires an understanding of the causal relationship between the environmental exposure (e.g., pollutant) and health outcomes, which is often uncertain.
    - Health impacts can either be directly related to exposure (anemia from lead poisoning) or indirectly related to exposure (such as school attendance, work productivity).
- Environmental health interventions cannot be evaluated within the same framework as other health interventions, which have a more narrowly defined scope and range of costs and benefits.
- Economic evaluations of environmental health interventions are highly uncertain, due to methodological difficulties, lack of reliable data and an inability to generalize findings across settings.

Despite some significant findings and impact for selected programs, there is a critical lack of economic evaluation studies for the wide-ranging, complex discipline of environmental health, particularly those focusing on ROI.

A framework for defining and evaluating environmental health interventions is needed to address these issues and, ultimately, to clearly articulate the critical value of environmental health interventions to reduce health care costs and improve quality of life.

# Introduction

Protection of our environment is key to increasing quality of life and years of healthy life. The environment surrounds us . . . the air we breathe, the water we drink, the food we eat and the homes and communities where we live. Our relationship to the environment impacts our health in a variety of ways. It has been estimated that the environment significantly affects more than 80 percent of major diseases (Prüss-Üstün & Corvalán, 2006). Environmental public health programs are part of the public health strategy to prevent and address the increase in diseases that are predicted to cost the U.S. health care system $4.2 trillion annually. Evidence shows that a large proportion of environmental disease could be prevented by cost-effective interventions such as clean water, clean air and basic safety measures (Prüss-Üstün & Corvalán, 2006).

Environmental factors that adversely impact health are wide-ranging and can include exposure to hazardous substances in the air, water, soil, and food, natural disasters, and housing. Environmental health services are instrumental in preventing or controlling disease, injury and disability related to the interactions between people and these environment hazards. Environmental public health interventions touch the lives of every American. These can include the provision of safe drinking water, clean air to breathe, safe food to eat, neighborhoods free from nuisances such as toxic waste and homes safe from hazards such as lead.

A recent study by the National Association of City and County Officials (NACCHO, 2013) found that the most frequently provided environmental health services by local health departments included food safety assurance, vector control, groundwater protection, indoor air quality and pollution prevention.

Over 40 years since the Environmental Protection Agency was established and environmental public health programs have expanded, Americans continue to have a limited understanding of the critical work conducted by local and state environmental health programs, including the costs and benefits of this work.

Challenges facing the field of environmental public health including dwindling financial and human resources with expanding pressures from traditional environmental health issues such as climate change and disaster preparedness concerns. Environmental public health deals with many complex issues that affect all of society in terms of quality of life and safety. The important contribution of the environment to the burden of disease necessitates greater attention to the efficiency of environmental health interventions, determining which give the greatest social return on limited public budgets.

It is a critical time for the field of environmental public health to articulate its value.

# Project Aim

The aim of this project was to review economic evaluation studies to better understand how U.S. researchers have measured environmental health programs' value and to better articulate the worth of such programs to the general public and policymakers. This was accomplished through a review of the literature that evaluated empirical, methodological and review papers about the costs and benefits of environmental health programs offered at the state and local levels in the U.S.

# Approach/Methodology

Materials and search terms were reviewed from two earlier searches conducted by the Centers for Disease Control and Prevention (CDC) librarians. University students, faculty and staff conducted a follow-up search using medical and environmental databases following up references in articles, as well as accessing grey literature through a variety of environmental and public health websites.

Scientific literature from 2002-2014 that researched environmental health interventions in public health were collected and reviewed. Close attention was paid to public and environmental health activities including prevention programs identifying environmental health risks, early exposure interventions, educational efforts, and surveillance programs.

Excluded from the analysis were studies that focused on tobacco (economic impact has been well established), chemicals including pesticides (chemical regulation typically falls under the jurisdiction of agriculture, not health department purview), and international programs (local and state health department activities were the specific focus of this report).

Studies exploring regulatory and policy economic evaluations were excluded from this report (e.g., Clean Air Act) but will be a focus of a report in phase two of this project. More information on the impact on public health and the economic impacts can be found in several reports, including reports to Congress issued by the U.S. Environmental Protection (http://www.epa.gov/air/sect812/prospective2.html).

Several databases were searched (PubMed, Web of Science, EconLit, Environmental Abstracts, Environmental Sciences Collection, Toxicology Abstracts, Toxline) using various combinations of keywords (cost-benefit analysis, cost effectiveness, return on investment, economic evaluation, economics, economic analysis, cost of illness, cost analysis, cost utility analysis, health care costs, environmental health, environmental exposure, environmental illness, environmental policy, environmental pollution, environmental health services, and environmental health programs).

# Program Areas

Environmental public health program areas that were explored: (1) food safety; (2) water quality; (3) lead exposures; (4) mercury exposures; (5) climate change; (6) housing; and (7) special populations including children and environmental justice communities. Environmental public health interventions may fail to adequately protect or support these vulnerable populations (Resnick & Portier, 2008).

Before the review of the literature process began, the NEHPC was briefed on the science of economic evaluation by Scott Grosse, PhD, Associate Director for Health Services Research and Evaluation, Division of Blood Disorders, CDC (September 6, 2012). He described and defined the wide range of economic evaluation analyses (e.g., cost-effectiveness, cost-benefit, return on investment) that are used and were considered in the review.

# Findings

A diversity of economic studies ranged from studies that focused on single economic variables to full economic evaluations. An ongoing interest in cost/benefit and return on investment, or ROI, has resulted in an increase in publications in the environmental public health field. Therefore, findings should not be considered comprehensive.

The search yielded 79 peer reviewed articles: 22 cost/burden of disease; 40 cost/benefit/cost-effectiveness; six methodology; and 11 ROI. Examination of the grey literature yielded 38 reports. Additional studies in effectiveness were also found and included in some sections of this report. Highlights from the search are summarized below.

## Food Safety

Ensuring a safe food supply is a fundamental role of public health. The Centers for Disease Control and Prevention (CDC, 2013) estimate that each year, 48 million people become ill from consuming contaminated food, over 128,000 are hospitalized and 3,000 die. Hospitalizations due to foodborne illnesses are estimated to cost over $3 billion dollars and lost productivity is estimated to cost between $20 billion and $40 billion each year. The U.S. Department of Agriculture (USDA) estimates foodborne illnesses are costing the United States economy more than $15.6 billion annually (CDC, 2013; Flynn, 2014).

- Hoffman et al. (2012) found that 14 of the 31 major foodborne pathogens account for an average of $14.0 billion in cost of illness and a loss of 61,000 Quality Adjusted Life Years (QALYs) per year.

- A report by Bekemeier et al. (2014) using the Public Health Activities and Services Tracking found that higher local health department spending on food safety and facility sanitation activities was related to a lower incidence of restaurant-related foodborne illness in Washington and a lower incidence of facility inspection-related waterborne disease in New York.

## Special Populations: Children

The environment can affect children's health very differently than adults' health. Children are often highly exposed to contaminants, and such contaminants affect children disproportionately because their bodies are not fully developed and their growing systems (e.g., neurological) can be more easily harmed. Children generally eat more food, drink more water and breathe more air relative to their size than adults do, and consequently may be exposed to relatively higher amounts of environmental contaminants. Children's normal activities, such as putting their hands in their mouths or playing on the ground, can result in environmental exposures that adults do not face (Axelrad et al., 2013). Finally, children have a long "shelf-life" with the potential for environmental exposures to negatively impact health over a lifetime.

Economic valuation of environmental health risks for children can be difficult, with the potential sources of economic uncertainties on the valuation of environmental health risks, particularly when comparing measures with adults to children (OECD, 2006). Despite this challenge, studies are emerging that have explored the costs and benefits of environmental public health programs for children.

- In a landmark study on children's health and the environment, Landrigan et al. (2002), estimated the contribution of environmental pollutants to the incidence, prevalence, mortality and costs of disease in American children. Using an environmentally attributable fraction, or EAF, model, the EAFs reported were 100% for lead poisoning, 30% for asthma, 5% for cancer, and 10% for neurobehavioral disorders. Total annual costs were estimated to be $54.9 billion (2.8% of total U.S. health care costs).

- Trasande and Liu (2011) found the costs associated with four categories of chronic childhood conditions – lead poisoning and methylmercury exposure, childhood cancer, developmental disabilities and asthma – totaled $76.6 billion in 2008.

- Supporting these findings, a study concluded that the annual cost of selected childhood diseases and disabilities attributable to environmental contaminants in Washington State was $1.875 billion in 2004 dollars, comprising $310.6 million ($ 0.3106 billion) in direct health care costs and $1.565 billion in indirect costs (Davies, 2006).

## Lead

A primary source of lead as a hazard for children is found in deteriorating lead-based paint and can lead to neurodevelopmental disabilities and other health conditions. The importance of lead remediation programs in reducing lead exposures and improving health has been a focus of many economic evaluation studies, with robust evidence using IQ losses as a measure of health (Gould, 2009; Landrigan, 2002). Grosse and Matte (2002) studied economic gains resulting from the reduction in children's exposure to lead since 1976. The estimated economic benefit for each year's cohort of 3.8 million 2-year-old children ranged from $110 billion to $319 billion.


For every **$1 invested** in lead paint hazard control, **a return of investment of $12–$155/household** or a net savings of $124–188 billion **was realized** (Gould, 2009).
$1
$12
$155

- Window replacement interventions have resulted in significant results (Dixon et al., 2012). Lead-safe window replacement resulted in net benefits of $67 billion from lost lifetime earnings, increased energy conservation and better property value (Nevin et al., 2008), and for every $1 invested in lead paint hazard control, an ROI of $12–$155/household or a net savings of $124 billion to 188 billion was realized (Gould, 2009). Gould (2009) modeled gains from lead paint abatement on IQ, health care, education and crime, with estimated gains at $200 to $320 billion for a five-year cohort.

- The Tennessee Lead Elimination Action Program, or TN LEAP, conducted an economic evaluation study using the economic Net Present Value (NPV). The NPV was calculated based on the expenses of lead hazard control and savings of lifetime earnings potential. The study found a positive economic payback with a NPV of $9 (Welborn et al., 2011).

Based on the compelling evidence, the Advisory Committee on Childhood Lead Poisoning Prevention (2012) recommends the following environmental public health interventions: the development and enforcement of lead-safe housing standards; and the adoption of prevention strategies to reduce environmental exposure from lead in soil, dust, paint and water before children are exposed. Although concern has been raised about lead in water and its impact on children's health, there has been no conclusive evidence indicating a significant association to health risks, and no economic evaluations of remediation (Sathyanarayana et al., 2006).

# Mercury

Methylmercury (MeHg) can adversely affect the neurological development of a fetus, infant or child, impacting cognitive thinking, memory, attention, language and fine motor and visual spatial skills. Methylmercury comes primarily from coal-fired plants, entering the air, then water,

and is ultimately found in fish that are consumed. Children with cord blood mercury levels > 5.8 µg/L have been associated with loss of IQ & economic productivity. Lost economic productivity was estimated to cost $8.7 billion annually (Trasande et al., 2005).

Trasande et al. (2006) determined that mercury-related losses of cognitive function from industrial emissions resulted in decreased economic productivity from diminished intelligence over a lifetime. This resulted in an aggregate economic cost in each annual birth cohort of $8.7 billion (with $1.3 billion of this cost attributable to mercury emitted from American coal-fired power plants), with strong implications for policies to reduce emissions.

Although environmental health interventions to screen MeHg levels and educate the public on safe fish consumption have been successful, no economic evaluation of such programs have been conducted (Imm et al., 2005; Knobeloch and Anderson, 2004).

## Special Populations: Environmental Justice Communities

Bullard (1996) defined environmental justice as the principle that "all people and communities are entitled to equal protection of environmental and public health laws and regulations." Exposures to pollution, unhealthy housing, limited neighborhood resources including green space, and other environmental risks that are unequally distributed by race and class can lead to disproportionate impacts on population health (Gibson et al., 2011a; Hutch et al., 2011; Wolf & Robbins, 2015).

Investing in low-income communities can reap substantial health gains. Mays (2013) found that a 10 percent increase in public health spending over 17 years led to a 4.3 percent reduction in infant mortality, as well as reductions in non-infant deaths from cardiovascular disease, diabetes, cancer and influenza. Health gains were 20-44 percent greater when funding was targeted to lower-income communities.

Research is needed to link disparities in environmental burdens to disparities in health and economic inequalities. Efforts to quantitatively measure and document environmental injustice have been complicated by having data of very different types and areas (such as zip codes, census tracts, or concentric circles) around polluting facilities or exposed populations (Mohai et al., 2009).

- One study found improvements in water/dampness issues, cockroaches and rodents, and reduced pesticide use in a low-income housing development after incorporating Enterprise Green Communities standards and Leadership in Energy & Environmental Design, or LEED, gold certification. Self-reported health improved significantly for adults living in the low-income housing development with anticipated reductions in health disparities. Economic evaluation for this intervention is needed (Jacobs et al., 2014).

Exposure to near-roadway traffic-related pollution and its association to asthma is a concern for low-income communities. A recent study estimated that 27,000 cases of childhood asthma (8% of total) in Los Angeles County were in some measure attributable to pollution associated with residential location within 75 meters of a major road. A 3.6% reduction of children living within 75 meters of a major road would result in 5,900 fewer asthma cases attributed to roadway exposure. Current exposures are attributed to 3,131 hospital admissions, 18,658 ED visits and 240,696 doctor visits, all of which can be avoided. Evidence suggests that urban development strategies and reduction of pollution exposure from roadways would significantly cut health care spending, particularly among low-income families (Perez et al., 2012).

## Climate Change

Public health engagement is critical to ensure the public health sector prepares for climate impacts but has been limited due to inadequate training and information, funding and resources, and workforce development (Rudolph & Berko, 2015). Limited but emerging data indicate that health, social and economic costs of climate change are vast, with one study

estimating health costs of six climate related events at approximately $14 billion, which is consistent with costs from other weather and climate disasters (Knowlton et al., 2011; Smith & Katz, 2013).

The public health sector has been key to responding to health impacts from climate change, for example establishing cooling centers during heat waves and coordinating health advisories. The American Public Health Association (2011) has outlined core strategies and activities for public health departments to consider to address emerging public health issues through adaptation plans and to mitigate climate changes through policy. Some of these activities may include disaster preparedness, surveillance and health impact assessment.

The CDC has developed the Building Resilience Against Climate Effects, or BRACE, framework to assist health officials in developing strategies and programs to help communities prepare for the health effects of climate change. Five sequential steps comprise the BRACE framework: (1) Identify the scope of climate impacts, associated potential health outcomes, populations and locations vulnerable to these health impacts; (2) Estimate or quantify the additional burden of health outcomes associated with climate change; (3) Identify the most suitable health interventions for the identified health impacts of greatest concern; (4) Develop a written adaptation plan that is regularly updated and disseminate and oversee implementation of the plan; and (5) Evaluate the process. BRACE incorporates the features of adaptive management using "best practices" from adaptation plans into a stepwise process customized for the specific needs of public health agencies and their communities. This process will support economic evaluation efforts around adaptation, climate and health (Marinucci et al., 2014).

- A paucity of economic evaluation literature exists that explores costs and benefits of adaptation measures (e.g., protecting health from heat events and climate change). Ebi et al. (2004) reported that the cost of running a heat–health warning system for Philadelphia was relatively small (USD $210,000) compared with the benefits of saving 117 lives (USD $468 million) over the three-year period of 1995–1998. Such findings can help guide public health departments as well as inform policymakers for implementing a wide range of adaptation measures.

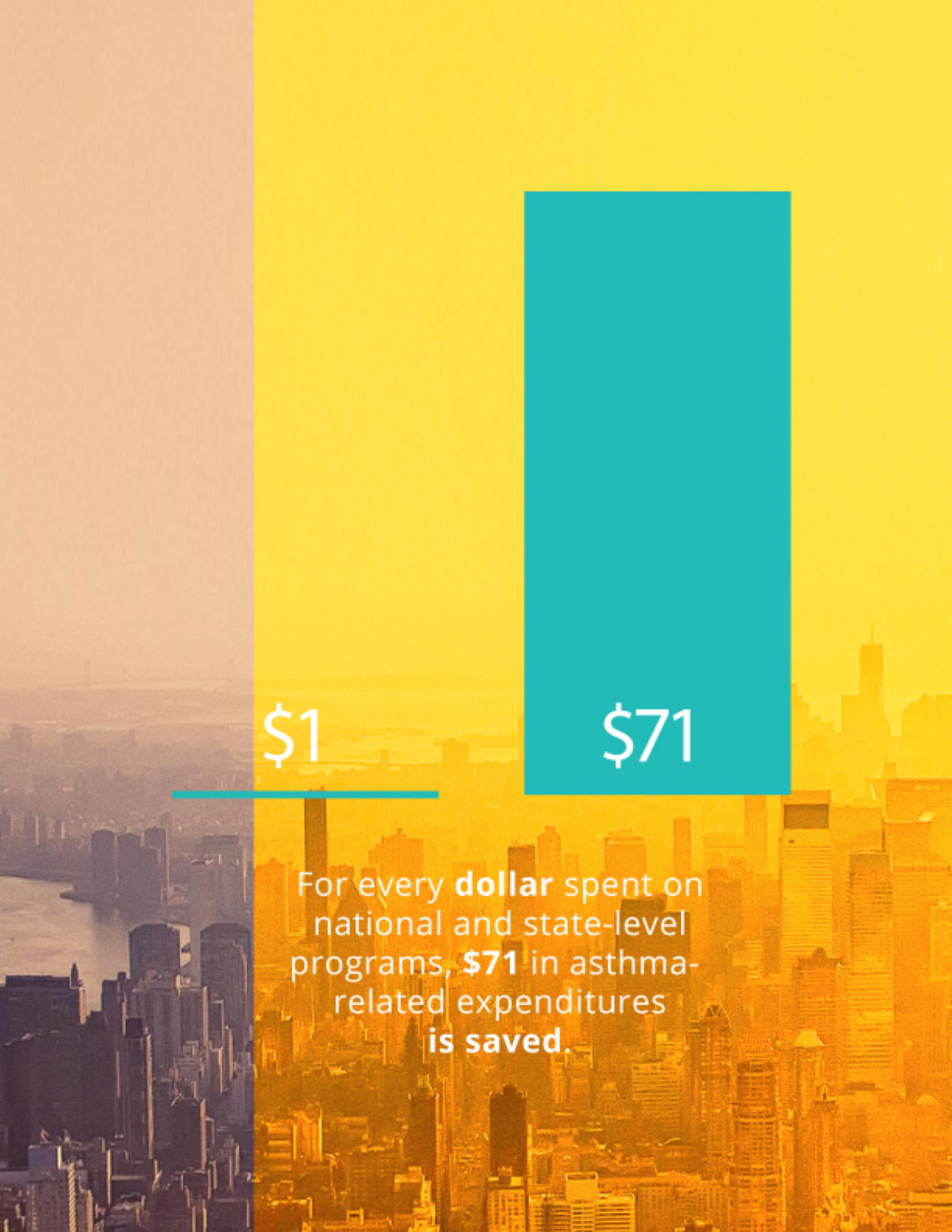
# Healthy Housing

Environmental hazards in the home harm millions of people each year. A variety of approaches to prevent diseases result from housing-related hazards such as lead and other contaminants. The CDC's National Asthma Control Program was launched in 1999 to address the rising public health impact of asthma. The program provides state funding for a variety of activities focused on surveillance, intervention, partnerships, and evaluation. The National Asthma Control Program's return on investment is compelling: for every dollar spent on national and state-level programs, $71 in asthma-related expenditures is saved (CDC, 2013).

A number of housing interventions have demonstrated a reduction in environmental health hazards and improved health (DiGuiseppi et al., 2010; Sandel et al., 2010). A large-scale review of home-based asthma interventions showed that for every dollar spent, the monetary value of averted medical costs or averted productivity losses was $5.30–$14 (in 2007 USD) (Tursynbek et al., 2011).

- A study by Sullivan et al. (2002) explored the cost-effectiveness of an education program and environmental control among children in urban areas with high levels of poverty. Outcomes included symptom-free days, cost per symptom-free day gained and annual costs of asthma morbidity compared by baseline symptom control, previous hospitalization and previous unscheduled physician visits. The intervention significantly reduced asthma symptoms. When compared with usual care, the intervention improved outcomes at an average additional cost of $9.20 per symptom-free day gained.

- A randomized controlled trial of adults receiving group education sessions in the clinic, by phone and at home as needed by an Asthma Nurse Specialist at a cost of $186 per patient saved $6,650 per patient in indirect and indirect health care expenditures ($36 saved in health care costs and lost work days for every $1 spent on the program) (Castro et al., 2003). A follow-up study found a 60 percent reduction in hospitalizations for frequent health care users when an Asthma Nurse Specialist was used to work with families (Castro et al., 2011).




For every **dollar** spent on national and state-level programs, **$71** in asthma-related expenditures **is saved**.

- The Connecticut Department of Health's Asthma Control Program developed the "Putting on AIRS" (Asthma Indoor Risk Strategies) Program to provide one-on-one education and environmental assessments to asthma patients and their families. An evaluation of the program demonstrated significant improvement in quality-of-life indicators compared to pre-enrollment in the AIRS program. Those indicators included reduced frequency of inhaler use, plus declines in emergency department visits (85%), asthma-related physician visits (67%), and days absent from school or work (62%). A net savings of $26,720 per 100 patients was estimated at six months follow-up (Nguyen et al., 2011).

Strong, consistent evidence in the economic evaluation studies in housing has resulted in the recommendation to use home-based, multi-trigger, multicomponent interventions. These interventions should have an environmental focus for children and adolescents with asthma, on the basis of evidence of effectiveness in reducing symptom-days, improving quality of life scores or symptom scores, and reducing the number of school days missed (Jacobs et al., 2010; Krieger et al., 2010; Nurmagambetov et al., 2011; Tursynbek et al., 2011).

# Summary of Findings

Environmental health programs are often cost-effective, reduce health care costs, and improve productivity, reducing the significant economic burden of disease in addition to improving the length and quality of people's lives.

Overall, there were three main benefits arising from environmental interventions:

- Impact on health status
- Impact on economic productivity
- Impact on expenditure patterns (e.g., medical)

The existing economic evaluation of environmental health interventions is relatively weak. Authors have provided a wide range of recommendations to improve future research (Almansa & Martinez-Paz, 2011; Farrow, 2012; Hanley et al., 2003; Hansjurgens, 2004; Jacobsen & Neuman, 2007; Mason & Brown, 2010; Mendelsohn & Olmstead, 2009).

These include:

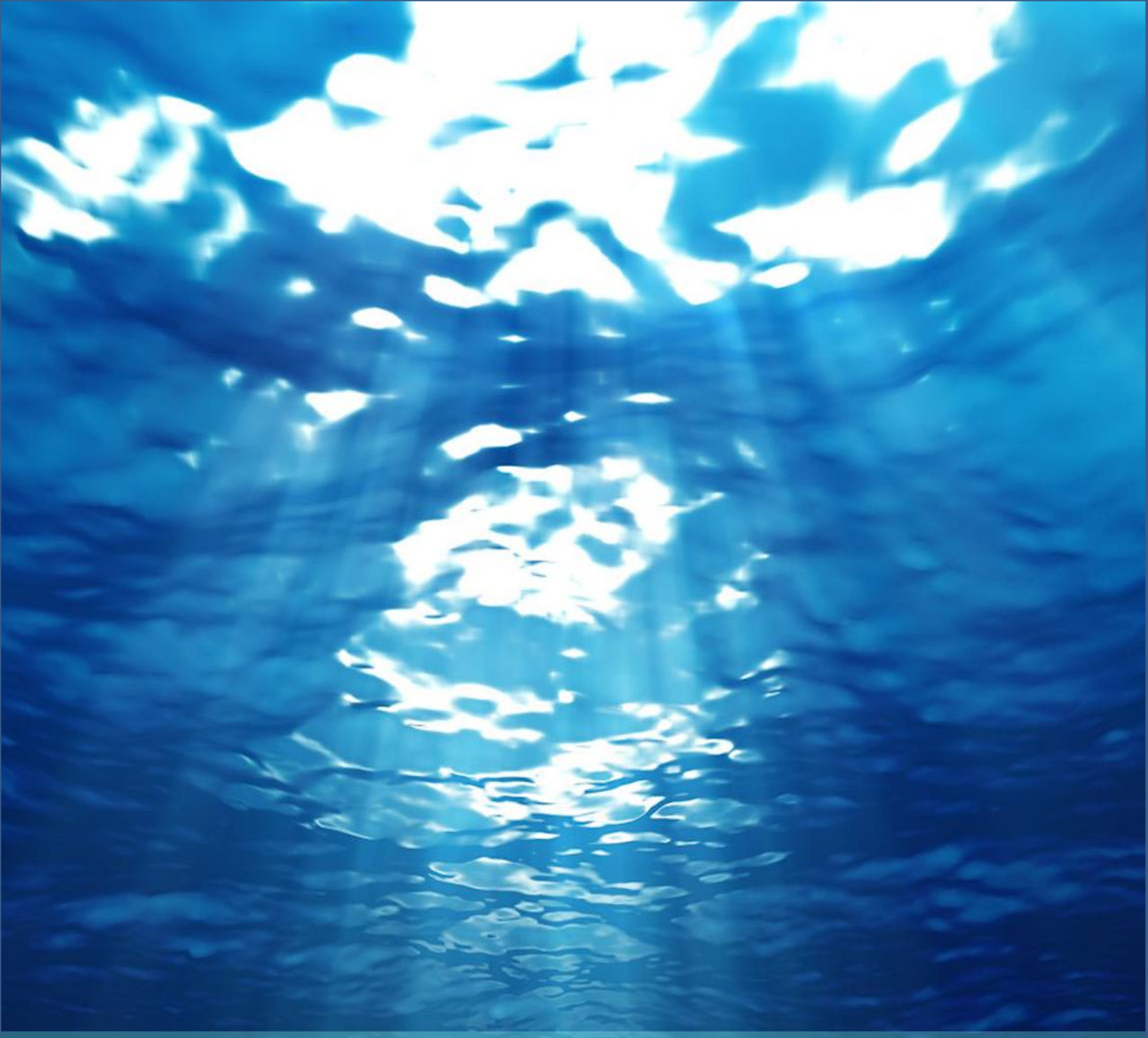
- Limited research on ROI: The majority of publications focused on cost-benefit or cost-effectiveness.
- Limited research on many environmental public health areas: Economic evaluation studies mainly focus on lead remediation, mercury exposure, childhood disease and asthma.
- Limited generalizability: Studies primarily focused on case studies or small geographic areas.
- Lacking a consistent, formal framework for valuation methodology.
- Limited guidance for measuring the non-monetary benefits, relying on economic measures.
- Difficult to compare findings: A variety of indicators are used and often times measured differently.

# Discussion

Overall, the economic evidence for environmental public health interventions remains relatively weak with too few studies per intervention, of variable scientific quality, and from diverse locations, which limits generalizability of findings. Despite their important contributions to the literature on intervention efficacy, most studies stopped short of articulating the full costs and benefits of the interventions.

Additionally, there exists a "disconnect" between economic research and environmental public health interventions, with a lack of translation of research findings into accessible documentation for policymakers. This is reflected in the low importance of economic evidence in budgeting decisions for environmental public health (Hutton, 2008).

Emerging research indicates that investment in environmental health services not only saves on health care costs, but significantly reduces deaths when compared to the provision of health care. Milstein et al. (2011) found that environmental interventions are a critical ingredient over time for lowering both the number of deaths and reducing health care costs, saving 90 percent more lives than health care and reducing costs by 30 percent in year 10. By year 25, that same investment in protection could save about 140 percent more lives and reduce costs by 62 percent.



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departments (National Association of County and City Health Officials, 2014) reported that many local health departments reduced or eliminated environmental health services for budgetary reasons.

***It is critical that environmental health services be viewed as absolute necessities for ensuring the health and safety of our citizens.***

# Valuing Environmental Health: Challenges

Measuring environmental benefits involves qualitative, quantitative and monetary assessment. Challenges include:

- Putting a price on human life, health, wellness, quality of life is difficult.
- Issues when costing out or averaging when not everyone lives in the same neighborhood.
- A variety of indicators are used and often used differently across studies.
- Environmental public health interventions cannot be evaluated within the same framework as other health interventions (they provide non-health benefits as well), whose scope is more narrowly defined due to the narrower range of costs and effects.

# Future Decisions

Society is increasingly faced with the challenge of addressing the burden of disease arising from environmental exposures. Capacity building in environment and health has been recognized as a critical need internationally (WHO, 2013).

A CBS/New York Times Poll found that a majority of Americans (58%) believe that protection of the environment should be given priority, even at the risk of curbing economic growth (https://assets.documentcloud.org/documents/2623880/full-resilts-of-the-new-york-times-cbs-news-poll.pdf). It is time to build on this interest and invest in environmental health interventions that have positive economic and health benefits.

Gibson et al. (2011b) examined the needs of states to improve environmental health outcomes by interviewing a diverse mix of stakeholders. Findings from this study and others provide a set of recommendations for public health agencies to consider:

Improve the tools for quantifying health outcomes:

- Quantify the total disease burden attributable to environmental hazards.
- Expand CDC's Environmental Public Health Tracking Network to link existing environmental and public health data by geographic location, helping local health departments improve surveillance activities and public health action.
- Conduct formal health impact assessments state and local transportation and land use planning processes.

Improve collection of economic data:

- Collect case studies by state that associate a reduction in health care costs as a result of environmental health interventions.
- Economic evaluation of environmental health interventions should provide more detailed cost classifications with recommendations for which non-health sector costs that should be included.

Increase comparative effectiveness research:

- May provide the foundation to scale up best practices nationwide.

Improve management of environmental health risks and public awareness:

- Prioritize environmental risks to health in each state.
- Provide state technical assistance for communities disproportionately affected by poor environmental quality.
- Develop environmental health public awareness campaigns such as the Frameworks Institute's *Building an Understanding of Environmental Health* series (http://frameworksinstitute.org/toolkits/environmentalhealth/).

# Conclusions

It is critical to demonstrate to policymakers and the public that investments in environmental health services add value to society. More economic studies are needed examining the costs and benefits of environmental health interventions to inform policymaking. There is an urgent need for health economic guidelines to ensure robust methods are used, giving comparable results. Using results of economic evaluation studies can lead to an increase in the uptake of economic evidence in decision-making.

## About the National Environmental Health Partnership Council

The National Environmental Health Partnership Council (NEHPC) is comprised of a variety of agencies and organizations that are dedicated to environmental health within the United States. The NEHPC strives to support healthy people by working for healthier environments.

The Council brings together diverse stakeholders to help expand and sustain awareness, education, policies and practices related to environmental health.

The Council strives to:

1. Build a collective voice in support of priority environmental health issues.
2. Foster and coordinate activities to advance environmental health.
3. Communicate new information and research to support better and more effective environmental health programs, practices and policies.
4. Promote ways to leverage current and future resources to maximize the impact of environmental health activities.
5. Generate momentum and build greater public awareness of the role that environmental health plays in sustaining and promoting human health.

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*Note: Endorsement from individual National Environmental Health Partnership Council members does not necessarily represent endorsement from the Council member's home organization. Participation in the National Environmental Health Partnership Council does not imply endorsement of this document.*

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