Committee on Science, Space, and Technology

Subcommittee on Environment

State of the Environment: Evaluating Progress and Priorities

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Testimony

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In thinking over the challenge of testifying about the past, present and future of environmental protection and public health, it seems to be reminiscent of the many times when at the end of a really productive day, when I should take satisfaction in all I've accomplished, I find that I actually have more to do than when I started the day

I'm usually further behind for two reasons: unforeseen challenges have been added to my work load, and at least some of the tasks that I have worked on are even more complex than I thought they were.

Our almost 50 years of environmental control is similar in that we can be proud about how much we have accomplished, but new challenges keep coming in, and we have learned so much more about how the environment affects our health and our social and economic well-being, that we know that there is much more that we can and should do.

The evidence that our environment is improving is plain to see, and I mean that literally. Bill Ruckelshaus, the first head of the EPA, appointed originally by President Nixon, and then by President Reagan, has joked that the reason that EPA was formed was that the people in Denver wanted to see their mountains - and the people in Los Angeles wanted to see each other. Mountains and people can now be seen. Our rivers are not on fire, pesticides are being controlled to better protect our natural environment and our health, and we no longer are allowing hazardous waste to despoil our water and our local environment. The tools provided by risk analysis and by advances in the sciences of toxicology, exposure assessment, epidemiology and economics have allowed us to identify environmental hazards affecting our health and our well-being that we cannot see or smell. But, despite our progress, for air and water and wastes we have new challenges to meet, both because of improvements in our science in detecting these challenges to our health and well being; and because our world has changed in so many ways, including how and where we live, the technologies that we use, and our connections to the rest of the world. We have also recognized how closely environmental concerns and environmental controls are related to much broader economic and social issues. In the next few minutes I will briefly describe some of the progress but will focus on the lessons learned and the challenges ahead which require a vibrant EPA supported by a strong scientific base to ensure our future. In view of the limitations of time and space, I will focus my discussion of the past and present on clean air issues; and of the future on sustainability as a way to meet the challenges of the day by incorporating economic and social considerations into environmental control.

Clean Air

Improvement in many aspects of air pollution is evident. For the six primary air quality pollutants there have all been significant decrements in ambient levels, reflecting the actions of states in responding to failure to attain standards, as well in many cases to other environmental efforts that have had the co-benefit of reducing emissions of primary air quality pollutants. But despite improvements, new science shows that some of the threats, notably from ozone and from particulates, are worse than we thought and are more challenging to control. Both of these pollutants exemplify my theme of how far we have come but yet how much further we need to go.

For both pollutants, advancing scientific information has led to evidence of significant adverse health effects at even lower pollutant levels and affecting more people than previously appreciated. Some of these effects are of obvious clinical importance, such as acute mortality, others are more subtle yet still significant.

The original 1970 outdoor air standard for particulates was based on total weight. This was the wrong target. Control measures, which predictably aimed at the heavier particles, did little to address fine particulates which are able to penetrate deeply into the lung and are responsible for the bulk of the adverse effects. The PM10 standard partially addressed this issue, but newer pollution measurement technology was needed to develop the PM 2.5 standard which more closely approximates particle sizes responsible for health effects. These advances in exposure science and toxicology, coupled with advances in the science of epidemiology, now clearly demonstrate the toll taken by fine particulates in the nation's health . To the evidence that daily variations in fine particulates are associated with a significant increase in mortality and morbidity has been added further evidence of the long term impact of breathing these particulates for many years. A recent study of a large Canadian national cohort followed for 20 years showed a statistically significant mortality increase down to levels of fine particulates that are well below our current standard (Crouse et al, 2012). Their overall findings on the impact of an increase in 10ug/m3 of fine particulates (PM2.5)on all non-accidental causes of death in Canada was 15%, and for deaths from ischemic heart disease was 31%. This is even larger than the 12-14%/per 10ug/m3 increased risk of cardiovascular mortality from long term exposure estimated by Chen (2008) from a systematic review of US and international studies, but is similar to the findings of the large American Cancer Society cohort study which estimated a 1.29 relative risk for a 10ug/m3 change in ambient PM 2.5 concentration (Krewski et al, 2009). Notably, a more recent study by Correia et al (2013) reported that a decrease in 10ug/m3 in fine particulates was associated with an increase in overall US life expectancy of 0.35 years.

For ozone, the change in standard from a one hour to an eight hour averaging period reflects the recognition that American society was changing in a way that put more people, and particularly children, at risk (Rombout et al, 1986). The one hour ozone standard initially reflected the action of sunlight on ozone precursors that accumulated in the air during the short well-defined morning rush hour in geographically well-defined cities. Such limited rush hours, unfortunately, are a thing of the past as traffic extends throughout the day, and urban sprawl is a fact of our life. We now recognize that ozone levels are usually highest downwind from cities in suburban areas. We also recognize that children are particularly vulnerable to the effects of ozone, and that children are likely to be outdoors exercising throughout the warm summer days which meteorologically promote ozone accumulation. The resultant change to an eight hour standard also was economically more appropriate as it led to avoiding control strategies that lessened the one hour peak merely by spreading the ozone exposure throughout the day. More recently, studies strongly suggesting an independent association of daily ozone levels with mortality have put further pressure on reducing the ozone standard to protect public health (CASAC, 2012).

Secondly, both fine particulates and ozone are not simple end of pipe products but rather are transformed in air from multiple precursors coming from multiple sources. A broad range of industries

and personal activities serve as the sources for these two pollutants. It is not surprising that each source points to another as being the major source. To most cost-effectively control both pollutants we need additional research focused on refining our ability to attribute sources. For fine particulates we have the added challenge of further determining the chemical and physical constituents that have the greater effect so we can more effectively direct control strategies. However, let me emphasize that based on present knowledge all sources of these two pollutants contribute to their formation and to their toxicity.

Both pollutants also exemplify the challenge of significant contributions coming from multiple small point sources. As just one example, the recent rapid increase in shale gas drilling in local areas that are already near or above ozone or fine particulate standards presents multiple small sources that may impact on attaining the area-wide health-based standard. While in the aggregate their emission levels would be subject to usual air pollution control considerations, the activities related to any single well may not exceed the allowable emission thresholds.

Estimates of the impacts of

One additional point in regards to the control of air pollution is worth noting. The Congressional requirement in the Clean Air Act that EPA review the scientific basis for the standard every five years has been highly instrumental in leading to more effective regulation. Contrary to the repeated erroneous statement that the NAAQS standards are routinely tightened, in the large majority of times the scientific review has led to no change in the existing standard, and at times has even led to relaxation or elimination of standards. Revisiting standards should be the norm for all environmental regulation.

Other Direct Sources of Environmental Pollution

Achieving clean water also exemplifies the issue of much progress but much more to be done. Spewing of wastes directly into water bodies is largely a thing of the past, due in large part to command and control regulatory approaches that make it far more efficient to develop processes that avoid waste as well as to better end-of-pipe control technologies. Through experience, industry has learned that it is usually far more cost-effective to design to avoid waste streams. But yet the dead zones in the Chesapeake and the Gulf of Mexico are stubborn problems because of non-point sources. EPA has shifted gears to develop guidelines for nutrient runoff which need to move forward using the best science. Similarly, while there has been great progress in decreasing the use of land as a place to dump wastes, new challenges continue to appear – electronic wastes just being one example.

Global Change

There is no question that Global Climate Change is occurring. George Bush, in his 2007 State of the Union address noted the “serious challenge of global climate change”. EPA received its first funding to look at this issue from President Ronald Reagan in 1984. It was well understood then that the extent to which sunlight radiated off of our planet into space affected surface temperature, and that carbon

dioxide was a major factor in absorbing this radiation thereby keeping its warmth on the Earth. It was clearly predicted then that a rise in global carbon dioxide would make the earth warmer and set in motion a variety of planetary climate changes of potentially major consequences to human well being. This prediction has been more than amply borne out by the temperature records. As I am sure we are all well aware, 2012 was by far the hottest year ever recorded in the United States – one count has us setting over 5 times more daily record highs than record lows. Among the overall scientific community only a relatively tiny handful of climate change deniers exist, and those few, as well as those who give them undeserved credence, need to at least wonder, as they compulsively quibble, the extent to which they bear responsibility for the consequences to the American public of our delay in addressing this important issue. But the threshold for action should not be the overwhelming evidence that is already in place. The threshold should be sufficient evidence to take out an insurance policy to protect the American public - a threshold level that we passed a long time ago. We need actions across our government, but particularly from congress and from EPA. These actions should fall under the heading of primary and secondary prevention. Primary prevention requires us to cut back on those factors which cause greenhouse gas emissions; and secondary prevention requires preparation to mitigate the consequences when they do occur. We want to avoid tertiary prevention, such as providing temporary homes for those affected by Superstorm Sandy, and the $70-100 billion economic consequences of such extreme storms. The choices are difficult and require careful evaluation of the inevitable tradeoffs. But it is a challenge that we must meet and we can only meet this challenge with a vibrant EPA and by a congress able to make tough decisions.

Let me provide an example of a contentious scientific issue which was largely resolved by the accumulating scientific evidence and, most importantly, by congressional action which had significant co-benefits. We do not hear much about acid rain any more, but in the 1970s and 1980s it was a major issue. The National Acid Precipitation Assessment Program, a cooperative effort among federal agencies, was successful in narrowing differences among scientists such that only the occasional scientist would still claim either that there was acid rain was no problem at all or, on the other side, that we faced imminent destruction of Northeastern forests and lake systems. Congressional action, most notably through a cap and trade program, has been eminently successful in removing sulfur oxides and nitrogen oxides emissions with a resulting partial response of acid-sensitive ecosystems, as well as the co-benefit of significant human health benefit as it was only later that we fully recognized the implications of these emissions to fine particle formation (Burns et al, 2011)

Global climate change is just one of the major challenges to effective protection of public health and the environment. There will be issues that now exist but have not been adequately recognized, some real, some alarmist. Looking backwards, household radon, a potent public health threat estimated to cause 21,000 deaths per year, only belatedly was recognized as a health concern. This recognition has led to mitigation of the risk. Similarly, I was at EPA when the realization of potentially high levels of asbestos in schools led Congress to pass the Asbestos School Hazard Abatement Act. Inevitably, there will be new technology that will require careful consideration of potential benefits and costs. When EPA was formed in 1970 the term nanotechnology had not been invented and the term cellular telephone would not have been understood. Nor was the public concerned about “frankenfoods”. In my estimation,

concern about GMO foods and cancer due to cell phones is largely misplaced, but I can say that only because of the science that has been developed to explore the issue – and EPA and other federal agencies such as NIEHS and FDA have been central to developing this science. On the other hand, nanotechnology and other emerging technologies present real issues that must be addressed in order to maximize economic benefits while minimizing risks

What will be the new challenges? Many will come from the same driving forces of today. New technologies will emerge that will need to be controlled. With expansion of the global economy some of these new technologies will come from countries that have far less rigorous command and control of potential adverse consequences than are now an integral part of environmental control in the United States and other developed countries. We already have seen that global pollution increasing with the rapid growth of the Chinese economy; and we know that the world's bulk chemical industry is shifting toward developing countries. Population growth continues to put additional pressures on the world's resources in ways that are no longer limited to a single country or region, and the changing interface between people and the environment, along with global climate change, may well lead to new challenges such as emerging infections that know no geographical boundaries. Nor are geographical boundaries as relevant to American business, meaning that for good or bad our economic well-being is more tied to world forces, including the environment, than in the past.

I have focused on EPA, but other agencies have been heavily involved in protecting human health and ecosystems. Scientific studies and assessments led by NIEHS and by CDC have been central to EPA's cost benefit analysis that finally removed lead from gasoline under President Reagan. Based on their knowledge, HUD and state and local agencies have begun the long overdue work needed to remove leaded paint from homes. HUD believes that lead abatement provides a major overall economic benefit. They estimated that in the first five years of operation of the Federal Residential Lead-Based Hazard Reduction Act the expenditure of $582 million would lead to $2.65 billion in total benefits (*add HUD ref)*. But it remains shameful how little has been done to rid our society of this menace which, in 2002, was estimated as costing the United States $43.4 billion dollars each year (Landrigan et al, 2002). (This group did a similar analysis of other childhood impacts of environmental agents on asthma, pediatric cancer and neurobehavioral disorders which led to a total cost estimate of 2.8% of US health care costs). EPA's recent strategic plan to address children's environmental issues contains many valuable approaches to this central issue in environmental health and in sustainability (EPA, 2013)

Economic Growth

Evidence of the overall economic value of environmental regulation is not hard to find. Some of the analyses are related to putting a cost to the adverse effects of environmental agents on human health, such as in the examples I have described above or in a recent study by the Rand Corporation reporting that the costs of air pollution from shale gas drilling activities in my home area of Southwest Pennsylvania in 2011 were estimated as $7.2 to $32 million. Other analyses, including early studies by Carpenter et al (1979) relating air pollution to hospitalizations, and more recent studies by Nordhaus

and his colleagues at Yale, have shown that air pollution damages exceed value added for numerous industrial sectors, most notably for coal-fired electric power generation. The EPA has recently released an SAB-reviewed report on this concluding that the overall benefits of the 1990 CAA far exceed costs (EPA, 2011).

There are of course arguments among economists as to how to estimate costs and benefits associated with environmental regulation – or any other type of regulation. I want to emphasize one aspect of regulatory command and control which has major benefits to our economy that cannot be readily measured. Our economic growth is heavily dependent upon venture capital investment in new technologies. Regulation lessens the uncertainty that is a hindrance to investment. As is clear from a perusal of its web sites, EPA is also very much involved in helping businesses meet regulatory requirements and in economic savings

Example Related to Anesthesiology

In considering how best to present to this committee why these newer global problems are so much more challenging than the older ones, I remembered a study my colleagues and I performed that was directly related to the field of anesthesiology. This, of course, is the medical specialty of the distinguished chair of this subcommittee, Congressman Harris. In the 1960s and 1970s a number of reports in the medical literature suggested that women who worked in operating rooms were more likely to have spontaneous abortions and to give birth to malformed fetuses. We published, in *Lancet (ref)*, evidence that energy devices used in the operating room, such as electric cauteries, X-rays and lasers, were causing chemical reactions with the anesthestic agents that had accumulated in operating room air. We hypothesized that the resulting derivatives might be responsible for developmental abnormalities. We did not get to follow up on these findings for a very good reason. The rules for hospitals changed to increase ventilation such that it is no longer possible for anesthetic gases to accumulate within the room, an approach which has the co-benefit of removing airborne infectious agents – the good news is that further studies have not shown reproductive and developmental risks in females working in operating rooms. This very good example of command and control simply will not work for global issues like climate change. One can open operating rooms to the outside, thereby protecting the inhabitants. There is no outside for our earth. If our hypothesis about anesthetic gases was correct, and the operating room was a fully closed system like our earth, the only protections would be within the operating room, such as preventing the release of anesthetic gases, or scavenging the agents within the room, or having operating room personnel wear gas masks. For global climate change, we must do our best to prevent the release of gases which underlay these changes, and work to lessen and to mitigate the effects. Ironically, the anesthetic study I described was performed in the operating rooms of Bellevue and University Hospitals, two of the five New York area hospitals shut down for more than a month by Superstorm Sandy – with an estimated $3.1 billion dollar cost to get them open again, as well as uncalculated consequences to the health of those dependent on the care provided by these hospitals.

Sustainability

Let me start my discussion of sustainability by thanking Chairman Harris and the Committee members for the charge to the witnesses at today's hearing to provide testimony related to the trade-offs that are necessary to achieve protection of human health and the environment. Beginning in November 2011, I chaired the National Research Council's Committee on Sustainability and the US Environmental Protection Agency. Our report focuses on just how to achieve these necessary tradeoffs. (NRC, 2012). I have attached some of the power point slides developed to describe the framework developed to promote sustainability at the US Environmental Protection Agency.

We began by recognizing that the challenges of today increasingly require working across the usual stovepipes that limit efficient response to wide-ranging multi-causal problems. We also recognized that there were many good examples of sustainable actions that provided social, economic and environmental benefits. Our approach to define sustainability was to point out that all of the constituent parts of sustainability are present in America's founding environmental law, NEPA, which was signed by President Nixon in 1969 – although the word sustainability had not yet been used in an environmental context. We learned much from the actions of major US and global industries in approaching sustainability as an economically viable and even necessary component of competition in the 21st century (see, for example, ICCA 2012). The resultant framework, shown in the attached figures, has a major emphasis on metrics without which we cannot understand whether we have made progress, and without which we cannot make the difficult choices among the many competing possibilities implicit in tradeoffs among competing interests. We also emphasize the need to develop tools that are capable of informing decisions made by Congress and regulatory agencies. With the development of these tools we anticipate that the questions raised by the Subcommittee can be answered in a way that benefits the American environment as well as providing health and economic benefits

Conclusion

When I prepare my course lectures I often imagine how the classes I teach now will be taught decades from now. My guess is that the first slide on the history of environmental policy will start with Command and Control beginning in 1970; Risk Assessment and Risk Management beginning in 1990; and Sustainability beginning in 2015. In each case the process actually was gathering steam before the date. As we describe in our NRC report on Sustainability at EPA, there are many examples in which sustainability practices are already under way, in which EPA and other agencies have learned to maximize benefits while minimizing risks by taking into account economic, social and environmental issues. It is also clear that the policy tools based on Command and Control and on Risk Assessment and Management will inevitably need to continue into the distant future. As we look back and see how these tools developed, it is apparent that the dates they began could have been earlier or later, depending upon the willingness of the American people and of Congress to accept and utilize these valuable tools. But we now have no choice. If we are to prosper as a nation, if we are to protect the health and well-being of Americans from the broad range of environmental hazards, we must move quickly to develop and adopt the thinking and tools of sustainability.

Finally, we today either can be optimistic about how far we have gone; or pessimistic about the challenges of the future. Classically, optimism and pessimism is defined in terms of whether we see the glass as half full or half empty. For a sustainable future, we must consider the glass to be twice the size it needs to be. EPA must be given a robust role if we are to right size this glass for the benefit of our health, our well-being and our ability as a nation to respond to future challenges

Thank you

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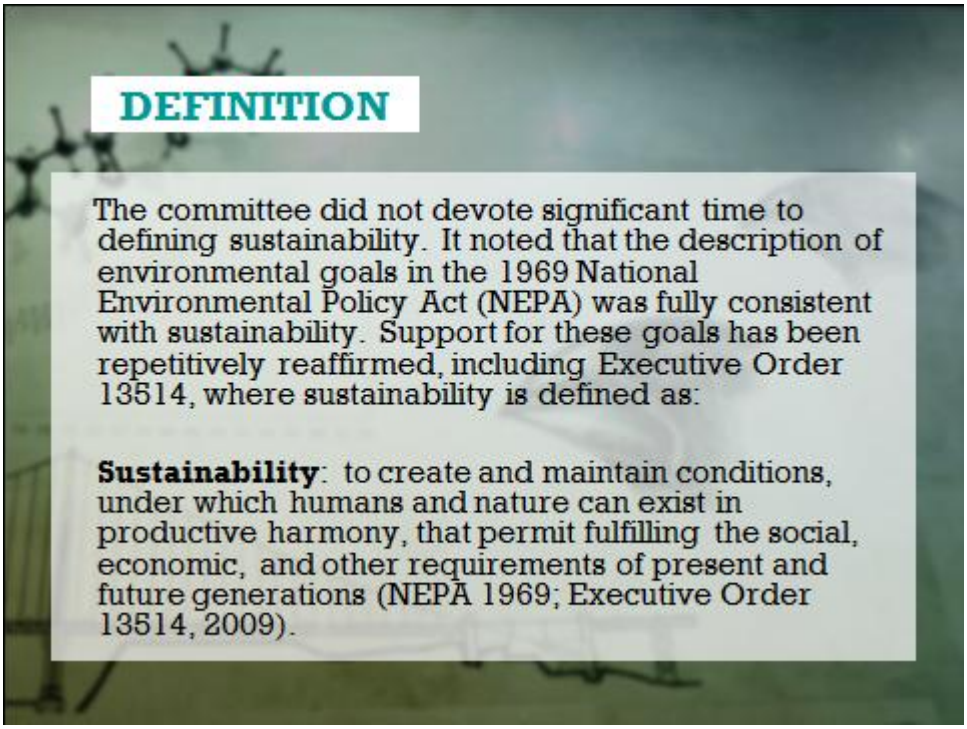
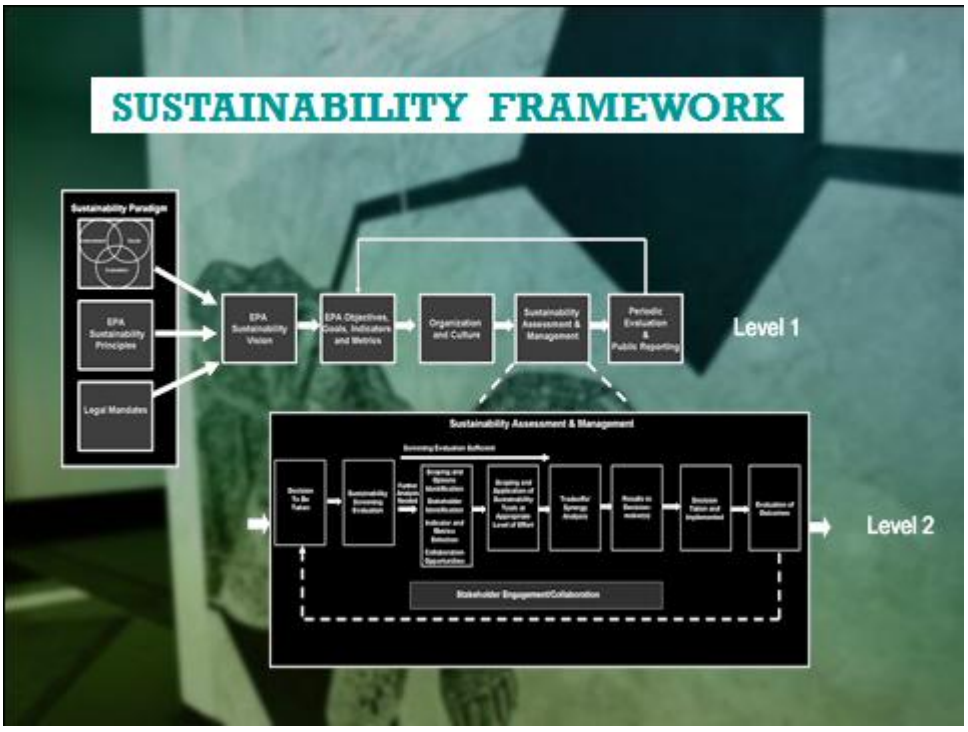
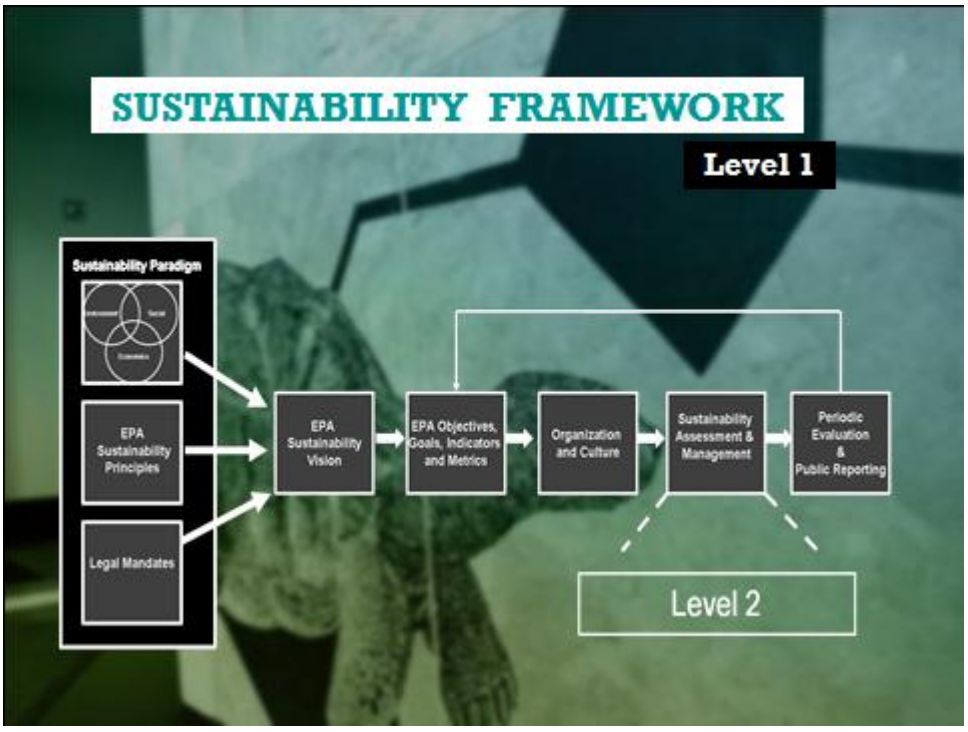



SUSTAINABILITY FRAMEWORK
Sustainability Paradigm
EPA Sustainability Principles
Legal Mandates
EPA Sustainability Vision
EPA Objectives, Goals, Indicators and Metrics
Organization and Culture
Sustainability Assessment & Management
Periodic Evaluation & Public Reporting
Level 1
Sustainability Assessment & Management
Level 2
Stakeholder Engagement/Collaboration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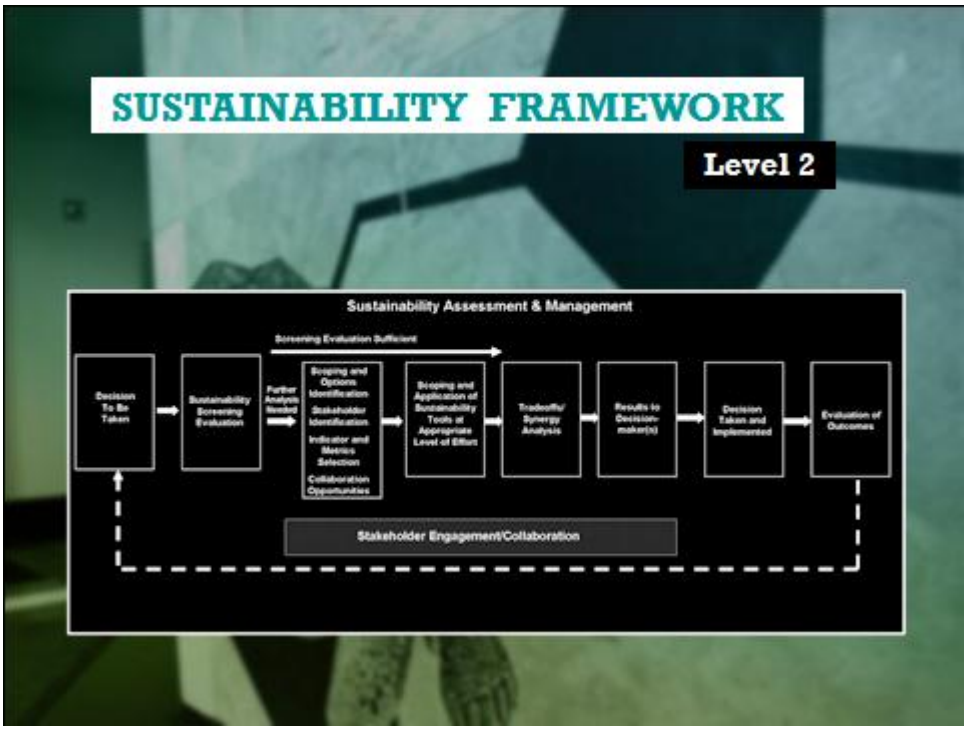
SUSTAINABILITY FRAMEWORK
Level 2
Sustainability Assessment & Management
Screening Evaluation Sufficient
Decision To Be Taken
Sustainability Screening Evaluation
Further Analysis Needed
Scoping and Options Identification
Stakeholder Identification
Indicator and Metrics Selection
Collaboration Opportunities
Scoping and Application of Sustainability Tools at Appropriate Level of Effort
Tradeoffs/ Synergy Analysis
Results to Decision-maker(s)
Decision Taken and Implemented
Evaluation of Outcomes
Stakeholder Engagement/Collaboration


EXAMPLES OF TOOLS
• Risk Assessment
• Life-Cycle Assessment
• Benefit-Cost Analysis
• Ecosystem Services Valuation
• Integrated Assessment Models
• Sustainability Impact Assessment
• Environmental Justice Tools
• Present and Future Scenario Tools

TRADEOFF AND SYNERGY ANALYSIS

- Tradeoff and synergy – key element of SAM
- The objective is to maximize synergies (social, environmental, and economic benefits of a decision) and to minimize the adverse effects of conflicts among the three pillars
- Important for EPA to establish a systematic way to analyze and quantify alternatives
  - e.g., spatially explicit models of multiple ecosystem services and biodiversity, Polasky, 2011
- Analysis can be used to identify new strategies that may improve results for key objectives

SUMMARY

- Overall management system framework for sustainability for the U.S. Environmental Protection Agency
- Approach driven by sustainability principles and goals and involves setting, meeting and reporting on measurable performance objectives
- Sustainability Assessment and Management (SAM) component incorporates sustainability into individual EPA decisions and actions