

CSTE Climate Change Pilot Summary Report

Background

In 2004, the Council of State and Territorial Epidemiologists (CSTE) brought together a group of epidemiologists to establish the State Environmental Health Indicators Collaborative (SEHIC) with the purpose of creating environmental public health indicators for surveillance. The climate change subcommittee, which later formed within SEHIC, comprehensively reviewed the scientific literature to identify outcomes and actions related to climate change that could provide information for recommendations to develop a suite of climate change environmental health indicators. Priority was then given to identifying longitudinal data sets that were applicable at the state and local levels. The workgroup recognized the need for indicators to measure current vulnerability to climate variability and change (the adaptation deficit). Indicators also are needed to track possible changes in health outcomes to determine whether climate change is affecting the geographic ranges and incidence of diseases. For both, some indicators are measures of environmental variables that directly or indirectly can affect human health, such as maximum and minimum temperature extremes. Some indicators can be used to project future health impacts based on changes in exposure, assuming exposure–response relationships remain constant over time and space.

The climate change workgroup developed a suite of 25 climate change indicators as described in English et al.¹ (**Table 1**), including, for each, instructions on calculating the indicator. However, these instructions had not been fully tested, nor had state data been generated by using these instructions. Thus, these indicators needed to be pilot tested so that the implementing instructions could be improved and finalized. With the results from this pilot, CSTE will finalize the climate change indicator documents and make them available on the CSTE website and by email to all state and local health departments and other interested professionals. The purpose of this document is to summarize successes of and issues raised during the pilot testing of the 25 climate change indicators.

Summary

To measure the impacts of climate change on human health along with state and local governments' efforts to address these concerns, a suite of indicators was developed and pilot tested to track environmental changes; related health outcomes trends; and developments in climate change mitigation, adaptation, and policy. States were solicited to participate in the pilot and asked to provide feedback on the parameters of each indicator, each indicator's perceived usefulness, and the likelihood of adoption by state or local health departments. Ten states and one municipality representing several regions with diverse climates participated in the pilot.

States reported that most climate change indicators have some level of usefulness. Because most pilot participants were health departments, indicators related to health outcomes were more relevant to their work. Additionally, many participants reported intending to use the indicators for strategic planning. Health outcome indicators were the most challenging for states

¹English PB, Sinclair AH, Ross Z, Anderson H, Boothe V, Davis C, et al. Environmental health indicators of climate change for the United States: findings from the State Environmental Health Indicator Collaborative. *Environ Health Perspect.* 2009;117:1673–81.

to complete because hospitalization, death, and injury data are often fragmented and incomplete. States, especially those with small populations, noted concern with sparse data that can contribute to unstable rates. Many policy indicators helped states identify partners for climate change efforts.

The successful pilot of these climate change indicators led to their adoption in participating state and local health departments. Improvements in data quality are needed, but many of these concerns are being addressed and may be resolved in coming years. Although comparison of data among states may not be appropriate, these indicators are valuable tools in strategic planning for climate change.

Pilot Participation

States were invited to participate in the climate change indicator pilot by submitting an application to the CSTE national office by February 25, 2011. The application required that states identify one person as the main point of contact, choose between completing all 25 indicators or half (13) of the indicators, list relevant technical or professional experience of personnel completing the pilot, and provide a proposed timeline for completion. CSTE chose three states and one municipality—Illinois; Montana; North Carolina; and Washington, DC—for funding through a competitive selection process to complete the 25 climate change indicators. These funded participants were required to participate in monthly conference calls, respond in a timely manner to emails from the CSTE national office, and provide monthly updates of progress and any difficulties encountered. Additionally, seven states—Arizona, Colorado, Florida, Michigan, Missouri, Washington, and Wisconsin—volunteered to complete climate change indicators without funding.

Methods

Indicator how-to guides (“guides”) for each climate change indicator were developed and written by climate change subcommittee members. All pilot participants were provided a template for recording data, guides, and additional instructions at the start of the pilot period on March 4, 2011. The time frame for which data was calculated differed for each indicator and was dependent on the availability of the data source for the years of interest.

Pilot Results

Data from the climate change indicators were submitted by May 20, 2011, along with an assessment that addressed the time required to complete each indicator (**Table 2**), perceived usefulness of the proposed indicators, and the likelihood that these indicators would be adopted by the state’s health department. The results are summarized in the following sections. Multistate data are presented in Appendix I.

Environmental Indicators (#1–6: Table 1)

The Greenhouse Gas Emissions indicator was reported to be easy to complete, and data acquisition was straightforward. Some participants indicated that adoption of this indicator was likely. The Air Mass Stagnation Events indicator was difficult for one pilot participant to

complete because they did not have a data-collection unit. Some states indicated that usefulness was low because this indicator does not pertain directly to health. One of the states noted that reporting the data year to year might have been more useful than reporting the data as a single aggregate over the entire 36-year period. Year-to-year reporting would allow for detection of trends and changes within the state over time.

Unfortunately, because of the temporary unavailability of the data source described in the guide during the pilot period, states were unable to complete the Max/Min and Diurnal Temperature indicator, bringing the total number of indicators piloted to 24 for most participants.

The Pollen indicator raised several concerns. Many states had difficulty locating data that were not available online. Obtaining the data directly from pollen-collection stations proved time consuming and problematic. Furthermore, inconsistencies in collection times created large gaps in the pollen count data because most stations had data available only for the previous 6 months, but the guide instructed reporting of several years' data. Ultimately, only four states were able to complete this indicator. The climate change workgroup will address these concerns after consulting the National Allergy Bureau. The indicator author also noted that the Pollen indicator was intended as a local measure and that each state would be expected to identify representative stations within the state. Currently this indicator is still under development pending data agreements to improve pollen data availability.

Data for the Number of Fires and Percentage of Total Acres Impacted By State indicator were easy to collect, and the guide was straightforward. Many states found this indicator useful for health departments because wildfires are commonly associated with air particulates that can affect respiratory and cardiovascular systems. Adoption was reported to be very likely for many states because interest in the data was high.

The Positive Test Results in Sentinels and Reservoirs (for West Nile Virus) indicator was reported to be easy to collect and the guide to be straightforward for most states. However, one state found the data too sparse because of small population sizes, which led to unstable rates. Another state saw wide variations from year to year in the submission of mosquitoes and sentinels for testing, which that state perceived to severely limit the usefulness of the indicator. Furthermore, one Eastern state noted that sentinel surveillance for other species also should be conducted for LaCrosse encephalitis, which would be more relevant to its region.

Health Outcomes Indicators (#7–12: Table 1)

Overall, data for the health outcomes indicators were the most challenging for states to collect because hospitalization, death, and injury data are often fragmented and require the most time to calculate. Nonetheless, at least eight of the eleven participants completed all the health outcomes indicators, except for the Allergic Disease indicator, which five states completed.

Data for the Rate of Heat Deaths, Hospitalizations, and Emergency Room Visits During Summer Months indicator were too sparse in most states to be stratified, and most states that completed this indicator reported state-level data rather than county-level data. One state indicated that emergency room visits data are not currently reported and surveillance was expected to begin in coming months. It was noted that, although the data is useful and adoption was likely, the difficulty in obtaining the data is an obstacle to using this indicator. Another state noted that cold weather–related deaths, hospitalizations, and emergency room visits should be considered as well. The climate change workgroup acknowledged that cold weather–related deaths might be a useful measure. However, it was determined that the current literature does not

provide strong enough evidence to support collection of such data. Many states reported a large time commitment to complete this indicator, ranging from 2 hours to 5 hours. Until more emergency room data is available, emergency room visits may be excluded from this indicator in the meantime.

Feedback was mixed regarding the Injuries and Deaths Due to Extreme Weather Events indicator. One state reported relative ease in calculating this indicator; while another state indicated that the numerous calculations for the 39 years of data were time consuming. Other states found the data easy to collect but supported the comment that the process was time consuming. There was concern that the data source averaged deaths and injuries over affected counties, and that substantial overlap might exist between the data reported for “storm” and for “flooding.” One state advised that using the category “storm” could be inclusive of deaths and injuries from flooding. Despite the differences in feedback, most states recognized the usefulness of this indicator and reported that health departments would most likely adopt it. The concern about overlap will be addressed after consulting with the Hazards and Vulnerability Research Institute, which manages the Spatial Hazard Events and Losses Database for the United States (SHELDUS) database used in the calculation of this indicator.

The Human Cases of Lyme Disease indicator was reported to be easy to collect; however, many states were unclear as to which state population data source should be used. Ultimately most used US census data. An Eastern state commented that other tickborne diseases, such as Rocky Mountain spotted fever, are more relevant because frequency of cases is higher than for Lyme disease in their region. The Human Cases of West Nile Virus indicator received comments similar to the Lyme disease indicator in which the same Eastern state indicated that other mosquito-borne diseases, such as LaCrosse encephalitis, would be more relevant there.

The Human Cases of Valley Fever, Dengue Fever, and Hantavirus indicator was not tested this pilot period because a guide was not developed in time.

The Allergic Disease indicator also proved to be one of the most challenging and time consuming for states to complete. Concerns about sparse data were similar to those for the Rate of Heat Deaths, Hospitalizations, and Emergency Room Visits During Summer Months indicator. It was noted that defining climate change and how it is linked with allergic disease was not effective; rather, diagnostic codes for asthma were used instead. Further concerns were that many of the diagnostic codes listed in the guide might not accurately reflect a link to climate change. For example, people with asthma triggered by food dyes would be included in this indicator but these cases would be unrelated to climate change. Similarly, it was indicated that the International Classification of Diseases, Ninth Revision (ICD-9) codes were not specific enough and the guide did not include the extensions to be used. Probably because of these issues, only five states completed this indicator, which took at least 5 hours. A tool to help states aggregate the data for groups of nearby counties will be made available to increase the statistical power of this measure. Also, the climate change subcommittee commented that this indicator should be used to track general allergic disease, and some misclassification might exist. However, because the incidence of misclassification and other possible confounders is consistent over time, possible misclassification should not affect the changes in trend over time that this measure would identify.

Mitigation Indicators (#13–15: Table 1)

The Total Energy Consumption Per Capita indicator guide was straightforward and easy to collect. Some states reported that this indicator was more time consuming than necessary because more detailed instructions about setting up the Excel spreadsheet for efficient calculations were needed. This issue will be addressed in the revised guide.

The Renewable Energy Consumption Per Capita indicator was easy to collect and straightforward for participants to complete.

States encountered some difficulty in locating the data for the Vehicle Miles Traveled indicator, and all reported missing data for 1992–1994. After data was obtained, calculations were simple and straightforward. The concern for missing data during 1992–1994 will be addressed in a revised version of the guide by excluding these years from the time frame analyzed.

Adaptation Indicators (#16–20: Table 1)

States described data for the Development of a State Adaptation Plan indicator as easy to collect, and completing it took less than an hour for most states. However, participants found this indicator's utility at the state level to be questionable and believed it is more useful at the national level.

Some states experienced difficulty in obtaining the documents required to complete the Access to Cooling Centers indicator because these data were not available on the state website. One state, needed to request the documents directly from the state police department, which delayed completion of this indicator for several weeks. Once the appropriate documents were obtained, most states commented on the ease of locating the needed information. Also, it was noted that the terminology was not familiar to several professionals who work in heat-related illness. In cold weather states, this indicator most likely would not be useful because there are few days of extremely high temperatures.

Participants reported no difficulties in completing the Heat Island Mitigation Plans indicator because the website presented the data in an easy-to-use format.

For the Health Surveillance Systems Related to Climate Change indicator, states reported multiple issues with obtaining the 2008-2009 Association of State and Territorial Health Officials (ASTHO) Climate Change Needs Assessment survey responses and identifying their state respondent. Also the guide lacked instructions for identifying the survey questions to which states would refer when completing this indicator. In fact, one state did not complete this indicator because of insufficient instructions. Ultimately only five states reported results for this indicator.

The same concerns applied to the Public Health Workforce Trained in Climate Change Research, Surveillance, and Adaptation indicator because they share the same data source, the 2008-2009 ASTHO survey. To address these issues, coordination with ASTHO to make the survey results more accessible to states will be explored. States can contact Surili Sutaria at ssutaria@astho.org to obtain their state survey responses.

Policy Indicators (#21–25: Table 1)

States reported the Development of a State Climate Change Advisory Board indicator to be easy to collect and the guide clearly written. Similarly, states did not report any problems in completing the Development of a State Climate Change Action Plan indicator, and the time commitment was short.

Most states reported ease in completing the Completion of a Greenhouse Gas Inventory indicator. However, there was concern that although inventories exist in two cities, most cities in the state do not have inventories and reporting a count, as opposed to a percentage, of cities with inventories might lead to misconception about the prevalence of completed green gas inventories at the state level.

For the Number and Percent of Local Governments Participating in ICLEI indicator, some states reported having to modify the guide to account for differences in counting in the numerator and denominator. One state reported that the local governments listed in ICLEI included both counties and cities and was concerned about double counting city populations because cities also would be included in county population estimate. Therefore, they modified the calculations.

States did not report any major concerns with the Percent of Population Living in Cities Participating in the U.S. Conference of Mayors Climate Protection Agreement indicator. However one state requested further clarification in the guide for using the US Census data. The guide will be revised to address this concern. One state noted that data from this indicator were shared with various health departments and offices during meetings, and another state highlighted this indicator's usefulness in identifying governments that view climate change as a problem. Using this indicator, states can identify local governments as partners for climate change efforts.

Feedback and Lessons Learned

States applauded the foresight to include mitigation, adaptation, and policy indicators alongside human health outcomes indicators. Many states were concerned that the medical community is not as sensitive as the public health community to the health effects of climate change. Some states suggested that more clarity was required to gather the data from the data sources, possibly through the use of screenshots. As a result of this feedback, screenshots were incorporated into many of the revised indicator guides. Additionally, states requested more consistency in the guides across indicators, which would include using the same population data (US Census) for calculating rates and maintaining the same level of detail across all the guides.

Table 1. 25 Climate Change Pilot Indicators

Environmental Indicators	
1.	Greenhouse Gas Emissions
2.	Air Mass Stagnation Events
3.	Max/Min and Diurnal Temperature
4.	Pollen
5.	Number of Fires and Percent of Total Acres Impacted By State
6.	Positive Test Results in Sentinels and Reservoirs (for West Nile Virus)
Health Outcome Indicators	
7.	Rate of Heat Deaths, Hospitalizations, and Emergency Room Visits During Summer Months
8.	Injuries and Deaths Due to Extreme Weather Events
9.	Human Cases of Lyme Disease
10.	Human Cases of West Nile Virus
11.	Human Cases of Valley Fever, Dengue Fever, and Hantavirus
12.	Allergic Disease
Mitigation Indicators	
13.	Total Energy Consumption Per Capita
14.	Renewable Energy Consumption Per Capita
15.	Vehicle Miles Traveled
Adaptation Indicators	
16.	Development of a State Adaptation Plan
17.	Access to Cooling Centers
18.	Heat Island Mitigation Plans
19.	Health Surveillance Systems Related to Climate Change
20.	Public Health Workforce Trained in Climate Change Research, Surveillance, and Adaptation
Policy Indicators	
21.	Development of a State Climate Change Advisory Board
22.	Development of a State Climate Change Action Plan
23.	Completion of a Greenhouse Gas Inventory
24.	Number and Percent of Local Governments Participating in ICLEI
25.	Percent of Population Living in Cities Participating in the U.S. Conference of Mayors Climate Protection Agreement

Table 2. Estimated time commitment and participant completion for each indicator reported by the 11 states participating in the climate change pilot study*

Indicator	DC	NC	AZ	FL	WA	MI	CO	No. Participants completing indicator
Environmental								
Greenhouse Gas Emissions	1 hr active time	0.67 hr	>0.50 hr, ~3 hr	15 min	0.5 hr	<1 hr	Short, <1 hr	11
Air Mass Stagnation Events	4 hr active time, 3 days total	0.67 hr	NA†	30 min	1.5 hr	~1–2 hr	Moderate, 90 min	10
Max/Min and Diurnal Temperature	NA	NA	NA	NA	NA	NA	NA	0
Pollen	2 hr active time, 3+ days total	2 hr	NA	NA	1 hr	NA	NA	4
Number of Fires and Percent of Total Acres Impacted by State	NA	0.67 hr	0.50 hr	20 min	0.25 hr	<1 hr	Short, <1 hr	10
Positive Test Results in Sentinels and Reservoirs (for West Nile Virus)	1 hr	0.67 hr	NA	1 hr	2.5 hr	1–2 hr, most time spent recording the county-by-county mosquito counts	NA	8
Health Outcome								
Rate of Heat Deaths, Hospitalizations, and Emergency Room Visits during Summer Months	5 hr	14 hr	NA	NA	NA	Very time-consuming, exact time NA	Long, >2 hr	8
Injuries and Deaths due to Extreme Weather Events	4 hr	1.17 hr	~4 hr	4 hr	3 hr	7–8 hrs	Moderate, 1–2 hr	9
Human Cases of Lyme Disease	2 hr	2.33 hr	0.50 hr	20 min	1.50 hr	1–2 hr	NA	9
Human Cases of West Nile Virus	2 hr	2.33 hr	0.50 hr	20 min	1 hr	1–2 hr	Moderate, 1–2 hr	9
Human Cases of Valley Fever, Dengue Fever, and Hantavirus	NA	NA	NA	NA	NA	NA	NA	NA
Allergic Disease	5+ hr	36.25 hr	NA	6 hr	NA	NA	NA	5

Indicator	DC	NC	AZ	FL	WA	MI	CO	No. Participants completing indicator
Mitigation								
Total Energy Consumption per Capita	5+ hr	5 hr	3 hrs	2 hr	1.50 hr	~ 2–3 hr	Moderate, 1–2 hr	11
Renewable Energy Consumption per Capita	23 hr	0.50 hr	0.25 hr	15 min	0.50 hr	<1 hr	NA	10
Vehicle Miles Traveled	2 hr	1.50 hr	0.25 hr	20 min	1 hr	1–2 hr	Short, <1 hr	11
Adaptation								
Development of a State Adaptation Plan	1 hr	0.08 hr	0.25 hr	5 min	0.25 hr	<15 min	Short, <1 hr	11
Access to Cooling Centers	1 hr	0.33 hr	~ 30 min	20 min	0.5 hr	<15 min	Short, <1 hr	11
Heat Island Mitigation Plans	<1 hr	0.17 hr	0.25 hr	5 min	0.25 hr	<15 min	NA	10
Health Surveillance Systems Related to Climate Change	<1 hr	1.25 hr	NA	NA	0.25 hr	NA	NA	5
Public Health Workforce Trained in Climate Change Research, Surveillance, and Adaptation	<1 hr	1.25 hr	NA	NA	0.5 hr	NA	NA	5
Policy								
Development of a State Climate Change Advisory Board	1 hr	0.08 hr	0.25 hr	5 min	0.25 hr	<15 min	Short, <1 hr	11
Development of a State Climate Change Action Plan	1 hr	0.08 hr	0.25 hr	5 min	0.25 hr	<15 min	Short, <1 hr	10
Completion of a Greenhouse Gas Inventory	1 hr	0.08 hr	0.25 hr	5 min	NA	<15 min	Short, <1 hr	11
Number and Percent of Local Governments Participating in ICLEI	1 hr	1.5 hr	NA	1 hr	0.50 hr	<1 hr	NA	9
Percent of Population Living in Cities Participating in U.S. Conference of Mayors Climate Protection Agreement	1 hr	1 hr	NA	30 min	0.25 hr	< 1 hr	Moderate, 1 – 2 hr	10

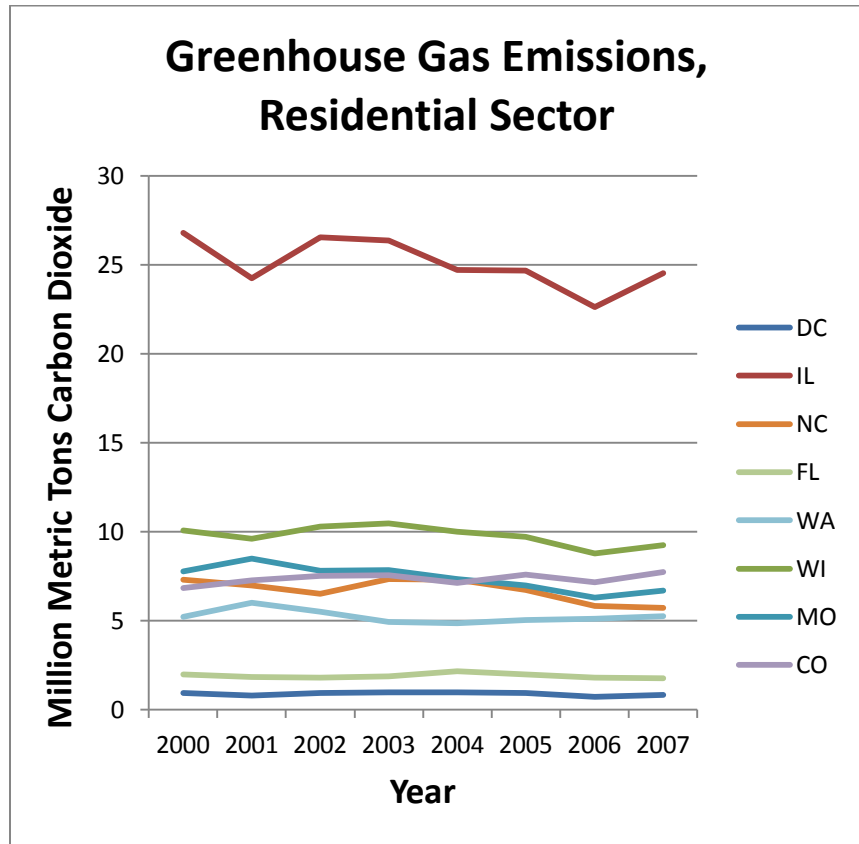
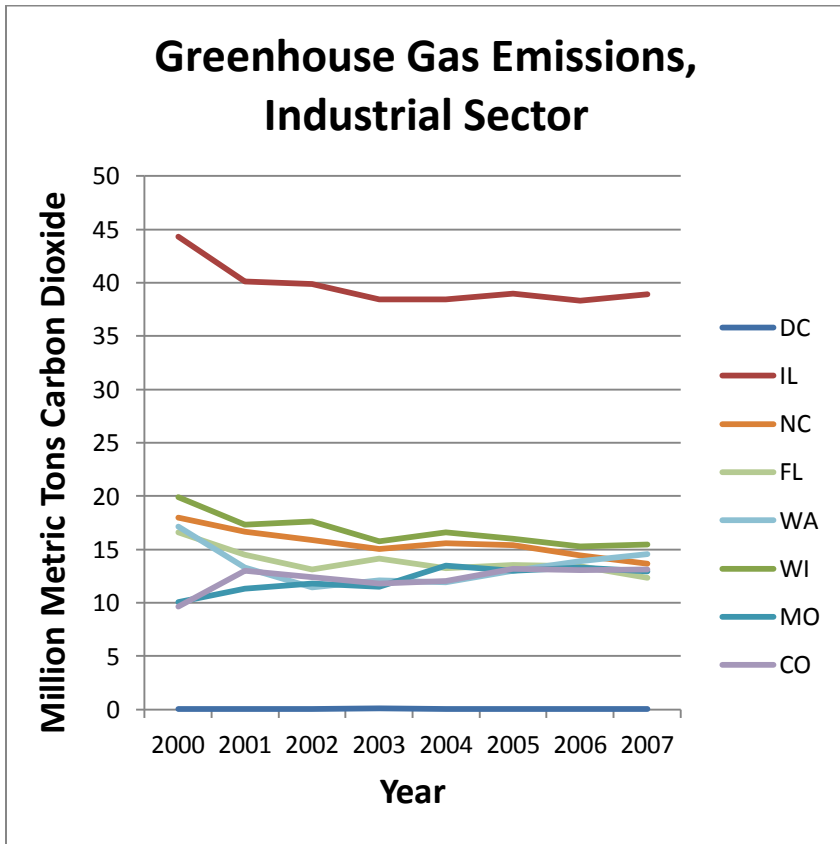
*IL, MT, WI, and MO did not provide individual time requirements for each indicator.

†NA = indicator not completed or time was not recorded.

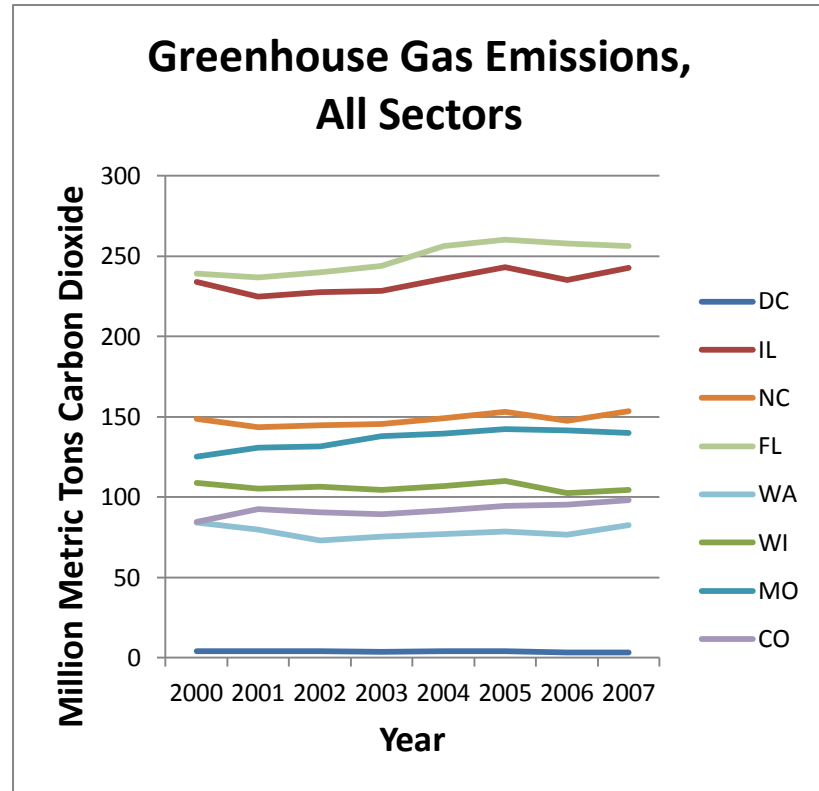
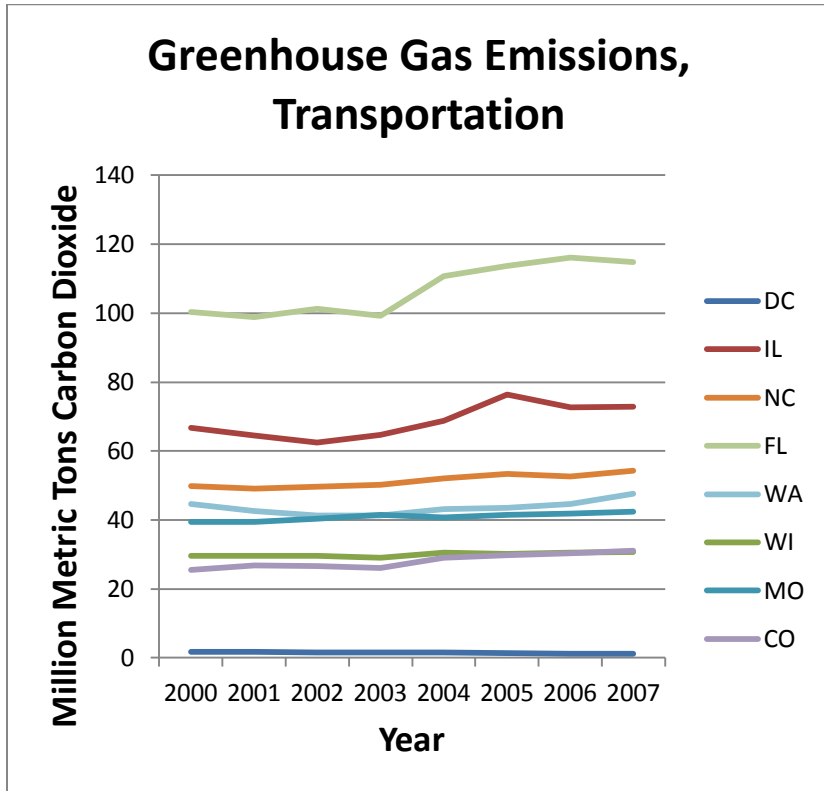
Appendix I.

Note: Montana, Arizona, and Michigan did not grant permission to display state-level data.

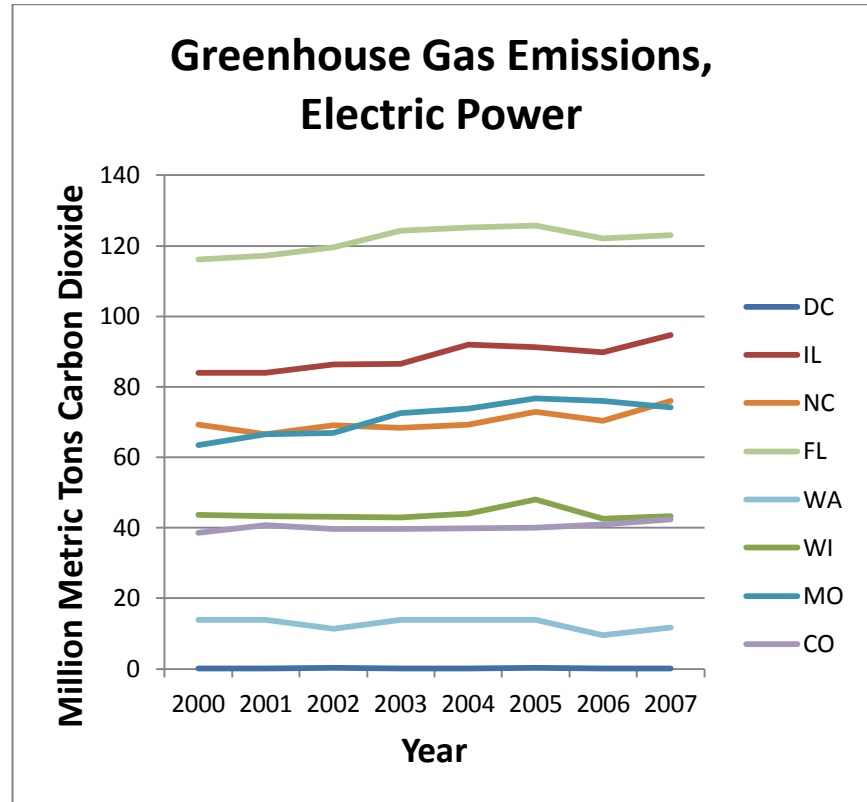
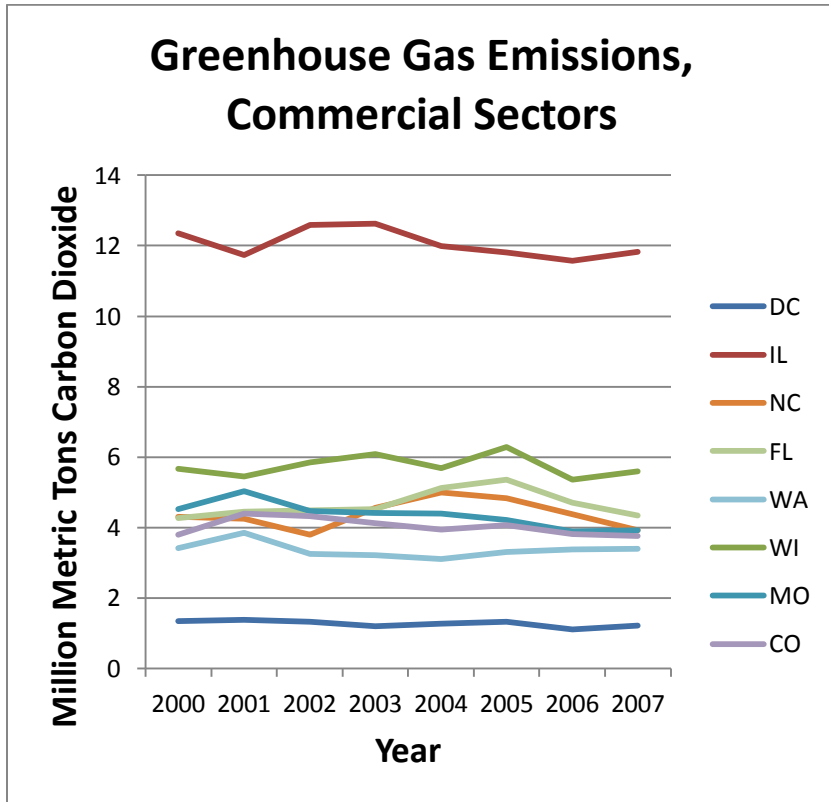
Indicator 1. Greenhouse Gas Emissions



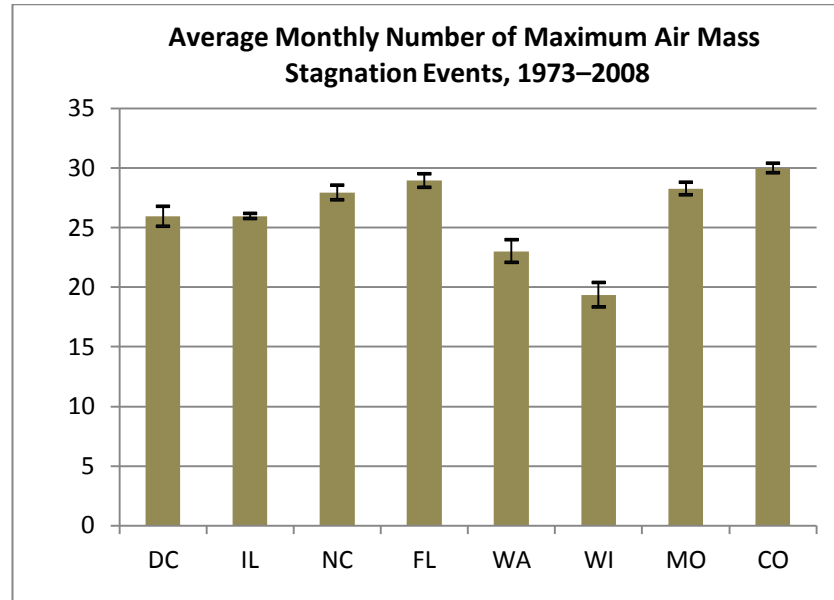
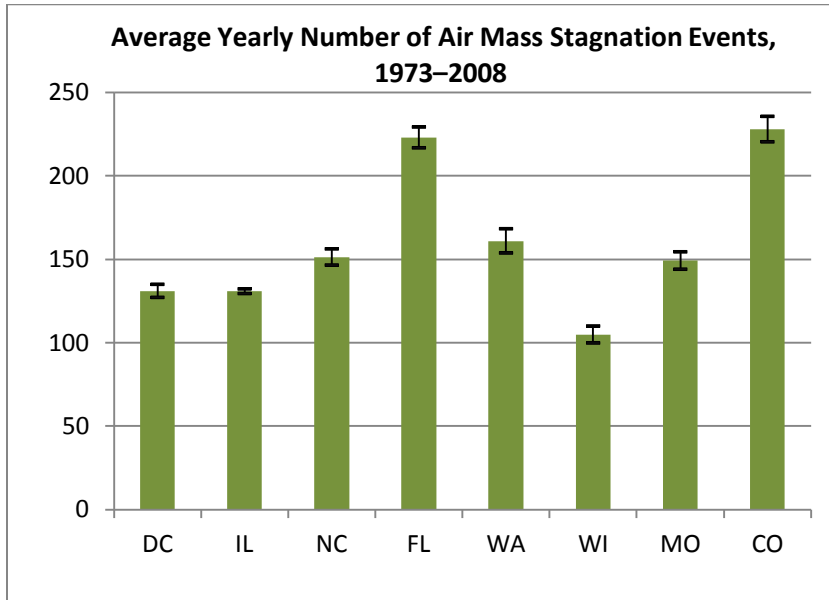
Indicator 1. Greenhouse Gas Emissions (continued)



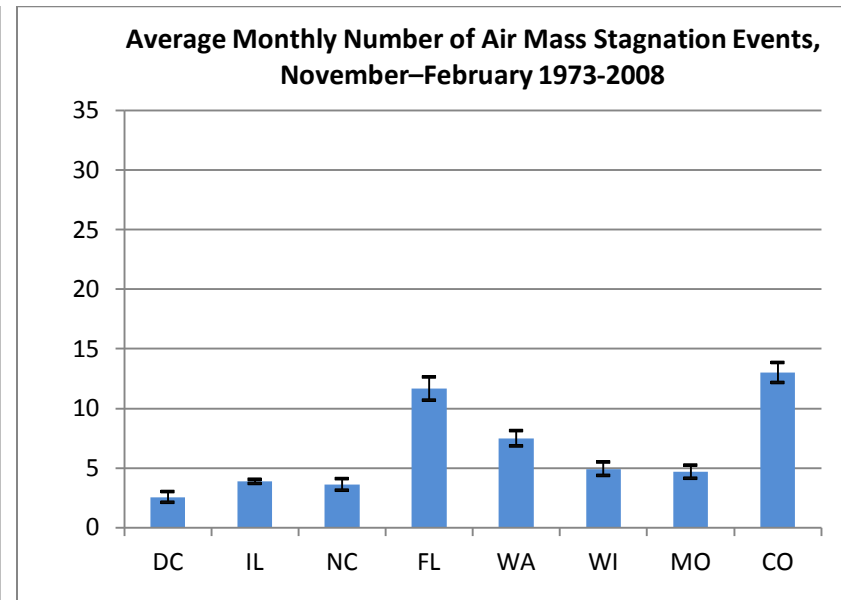
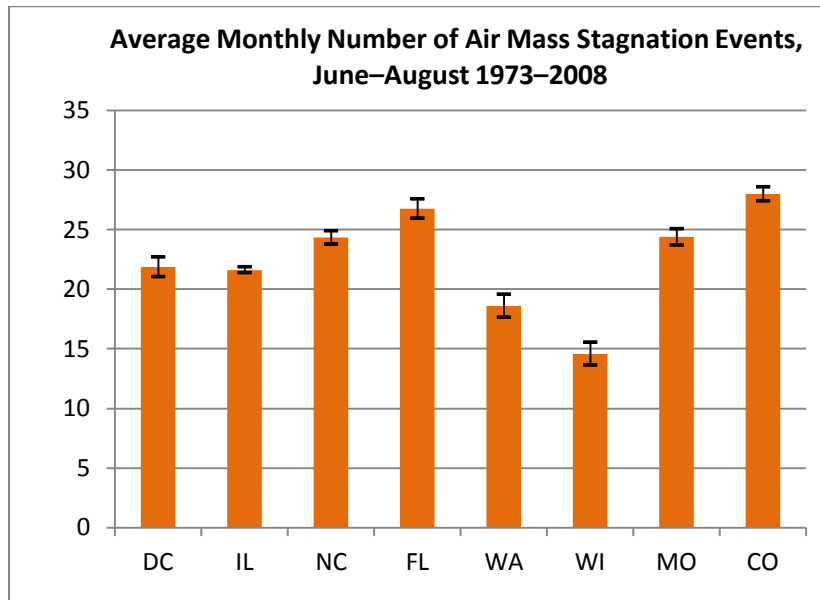
Indicator 1. Greenhouse Gas Emissions (continued)



Indicator 2. Air Mass Stagnation Events.



Indicator 2. Air Mass Stagnation Events (continued)



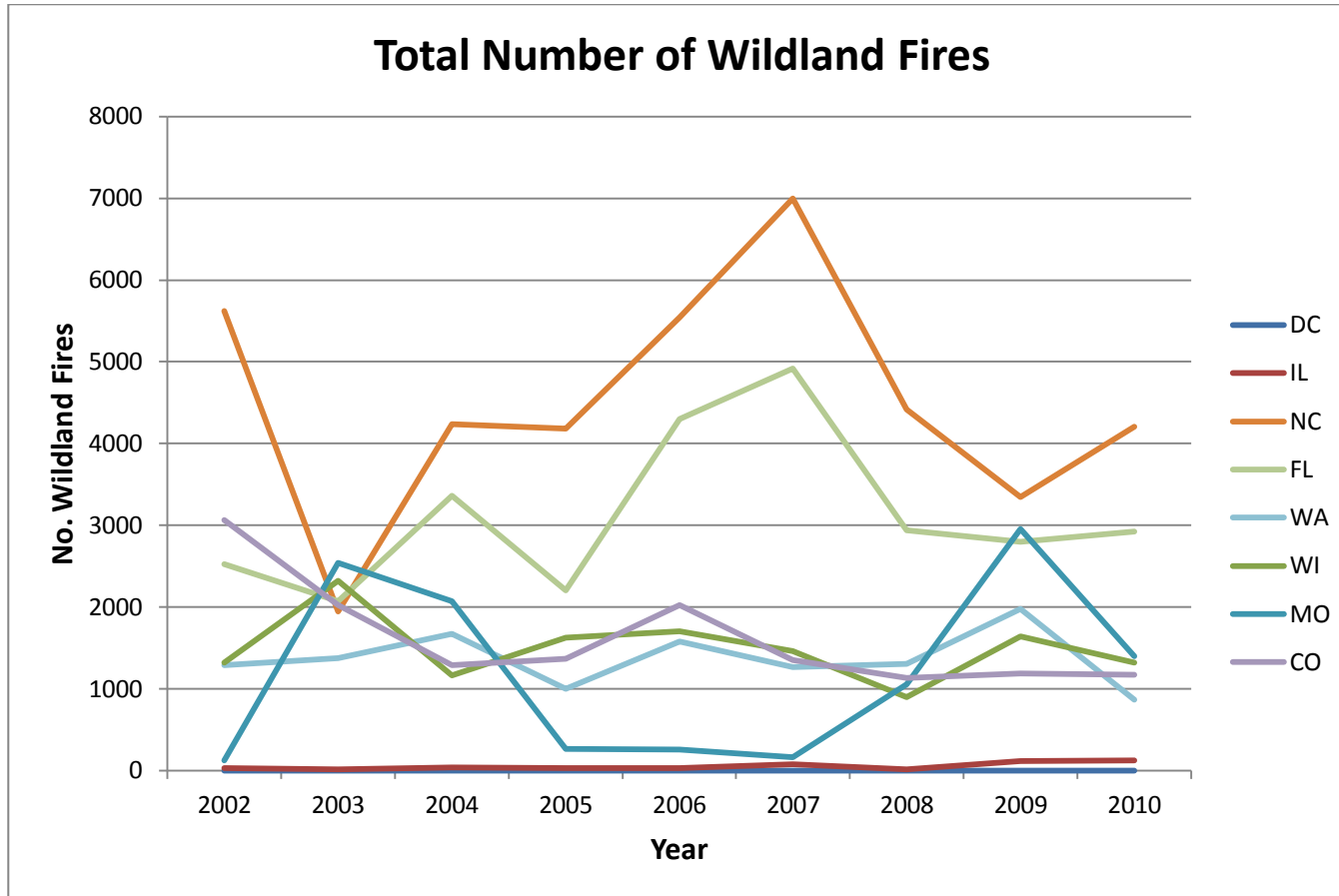
Indicator 3. Max/Min and Diurnal Temperature

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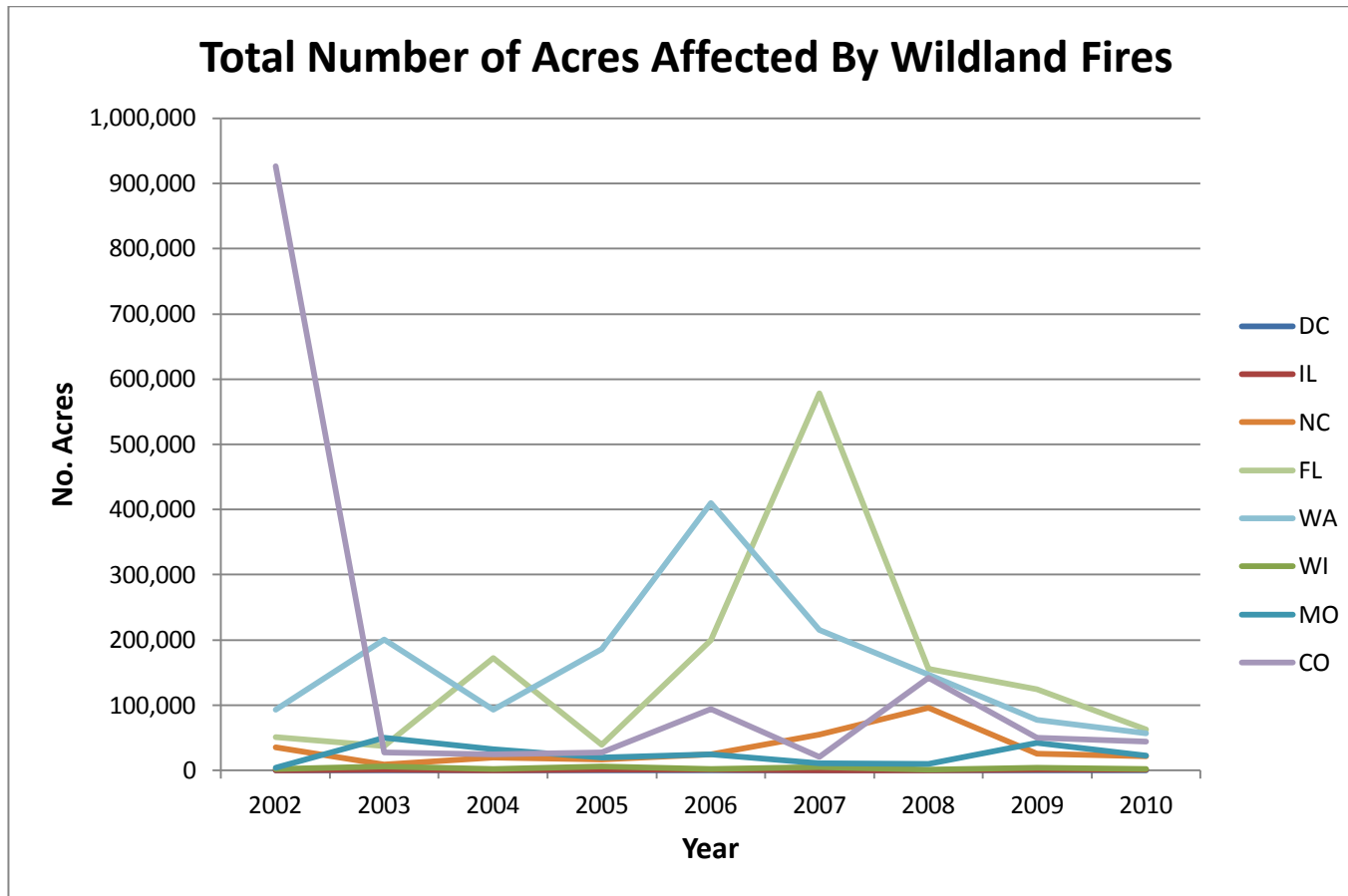
Indicator 4. Pollen Counts

Because fewer than half of participants completed this indicator, the data are not presented.

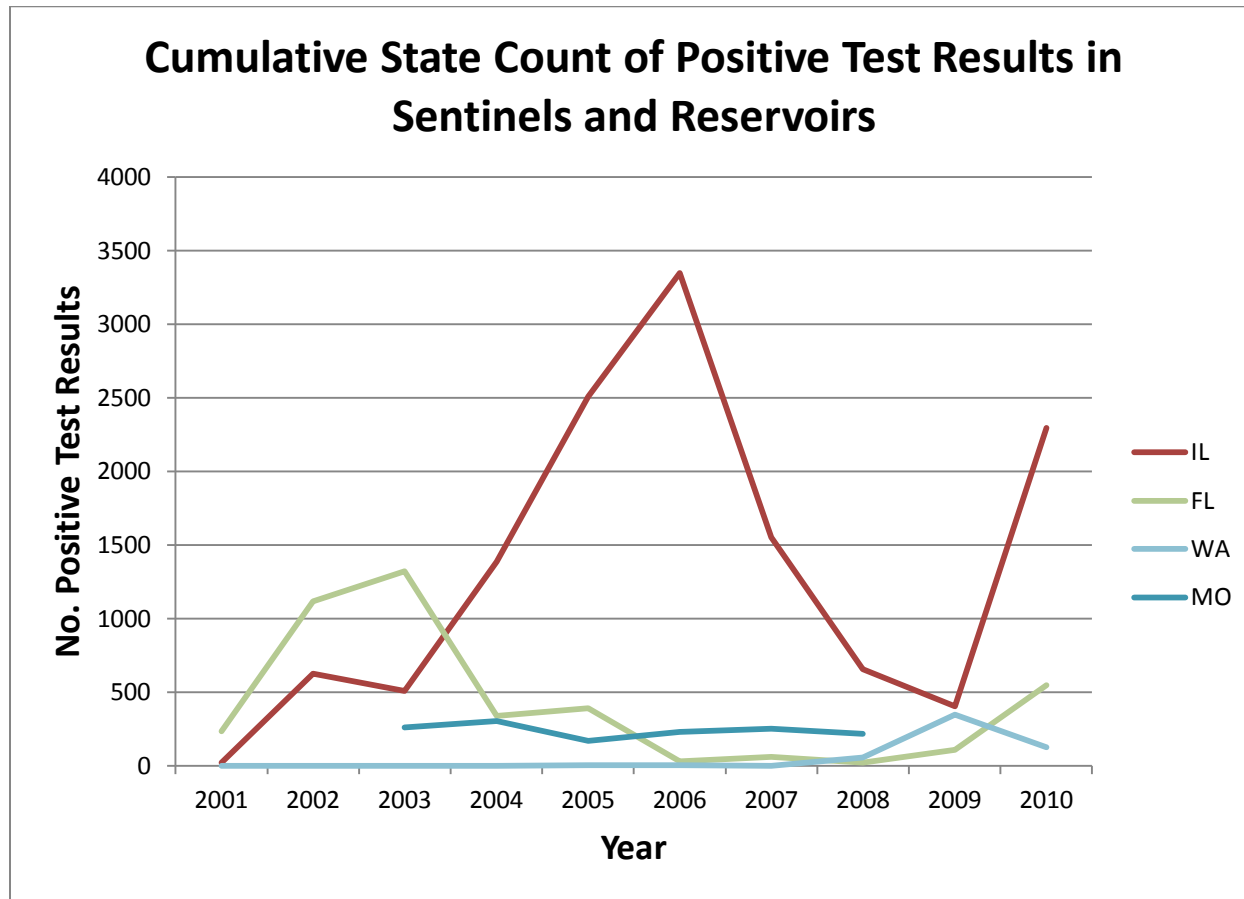
Indicator 5. Number of Fires and Percent of Total Acres Impacted by State



Indicator 5. Number of Fires and Percent of Total Acres Impacted by State (continued)



Indicator 6. Positive Test Results in Sentinels and Reservoirs (for West Nile Virus)



Indicator 7. Rate of Heat Deaths, Hospitalizations, and Emergency Room Visits During Summer Months

Because the data for this indicator were sparse, they are not presented.

Indicator 8. Injuries and Deaths Due to Extreme Weather Events

Because the data for this indicator were sparse, they are not presented.

Indicator 9. Human Cases of Lyme Disease

Because the data for this indicator were sparse, they are not presented.

Indicator 10. Human Cases of West Nile Virus

Because the data for this indicator were sparse, they are not presented.

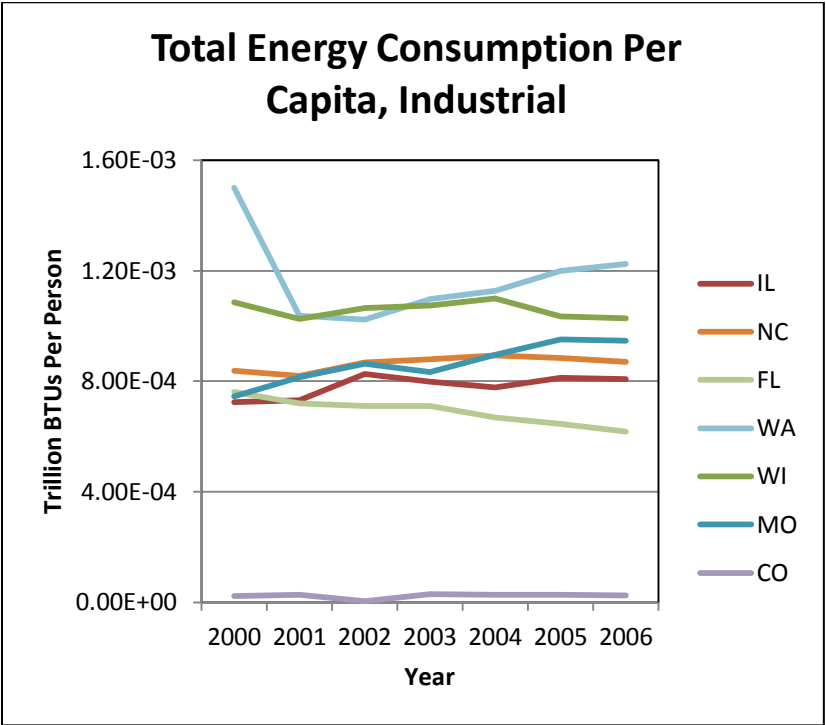
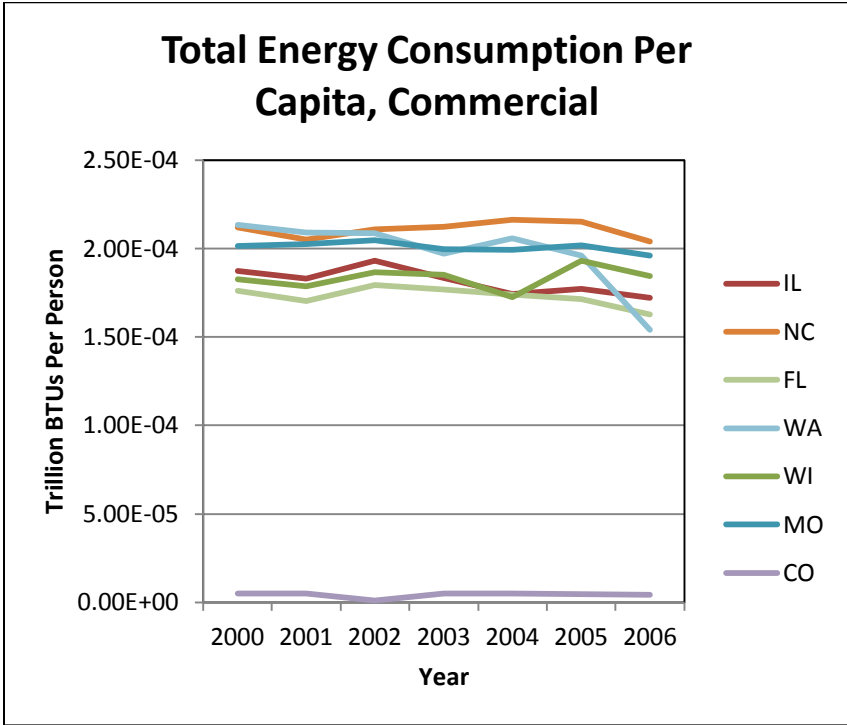
Indicator 11. Human Cases of Valley, Dengue Fever, and Hantavirus

This indicator was not completed as part of the climate change pilot.

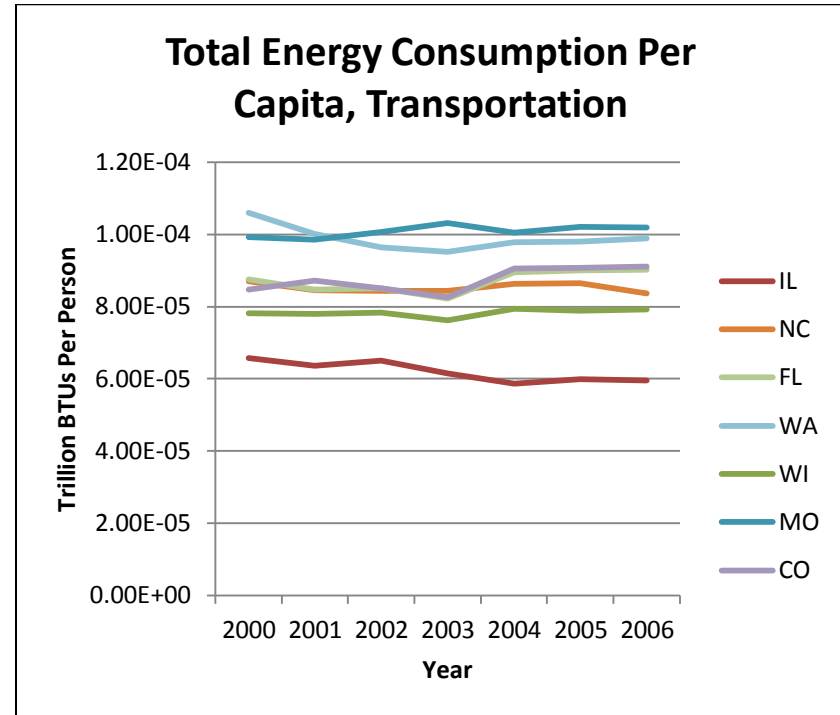
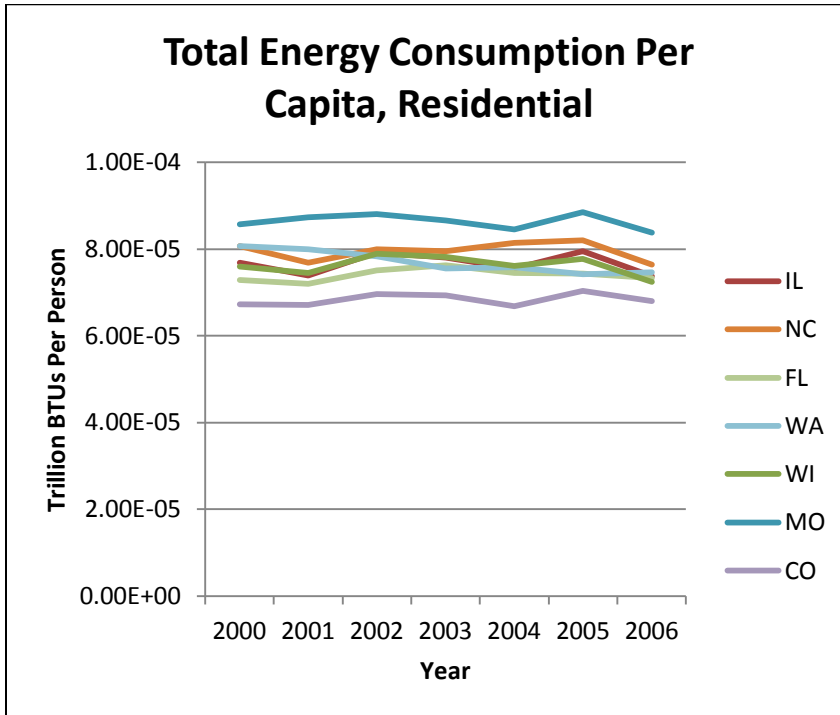
Indicator 12. Allergic Disease

Because fewer than half of participants completed this indicator, data are not presented.

Indicator 13. Total Energy Consumption Per Capita



Indicator 13. Total Energy Consumption Per Capita (continued)

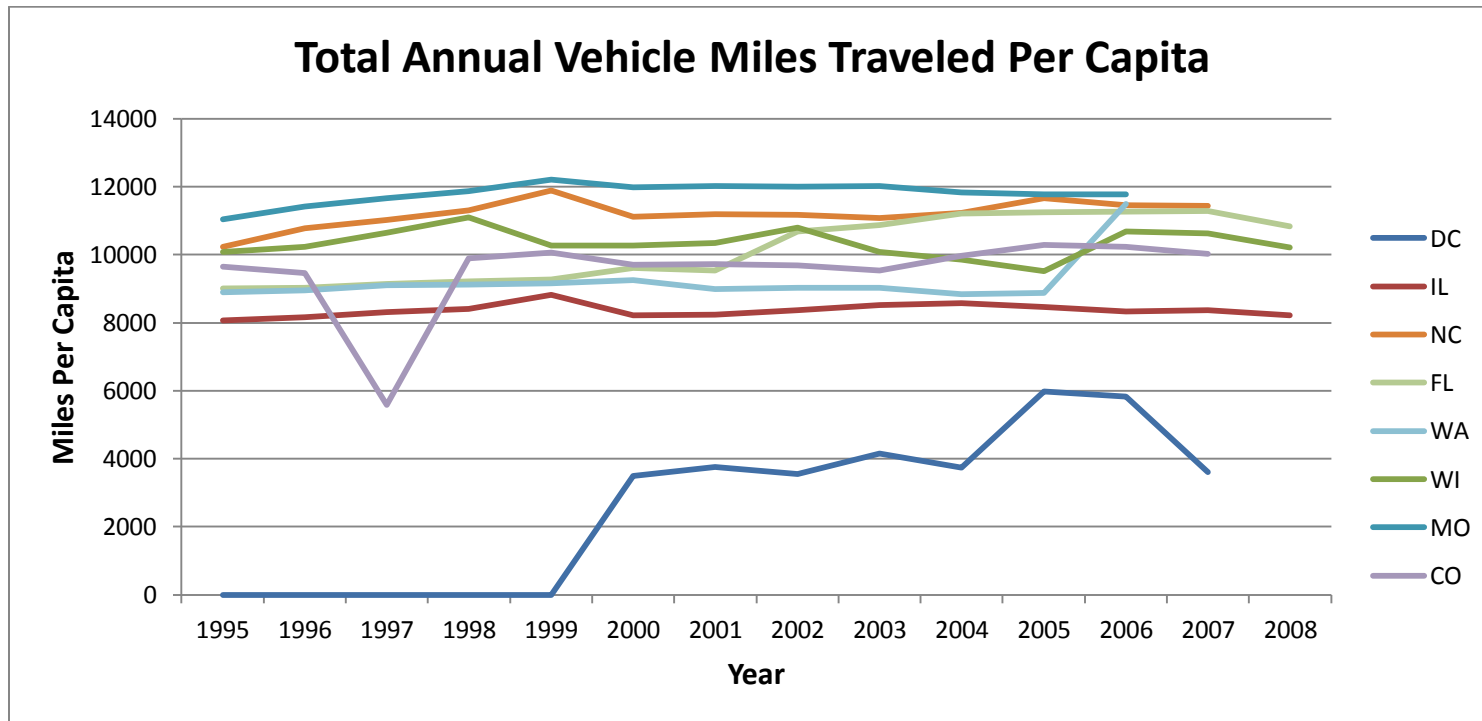


Indicator 14. Renewable Energy Consumption Per Capita

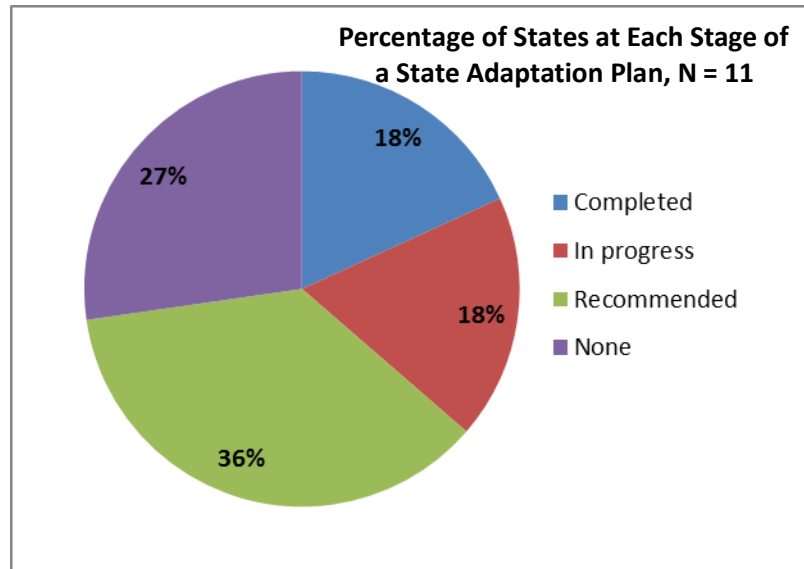
Renewable Energy Consumption (Thousand Kilowatt Hours Per Person)							
Year	DC	IL	NC	FL	WA	WI	MO
2006	1.00	NA	0.64	0.25	13.26	0.53	0.04
2007	1.10	0.11	0.51	0.24	12.76	0.51	0.21
2008	1.10	0.25	0.54	0.24	NA	0.60	0.39

NA = Data not available

Indicator 15. Vehicle Miles Traveled



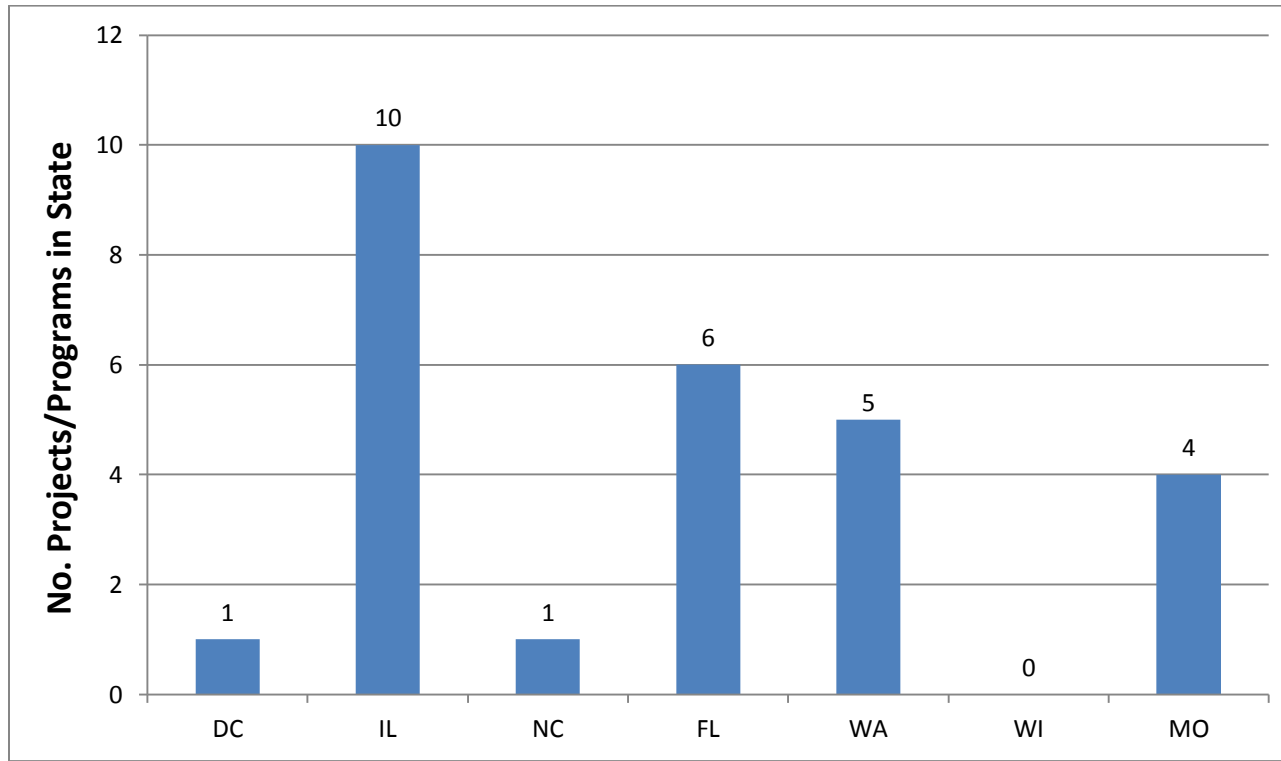
Indicator 16. Development of a State Adaptation Plan



Indicator 17. Access to Cooling Centers

Measure	No. (%) Reporting Yes (N = 11)
Identification of Extreme Heat as a Hazard	9 (82%)
Inclusion of Cooling Centers as an Example of Emergency Response Measures during Extreme Heat Events	3 (27%)

Indicator 18. Heat Island Mitigation Plans



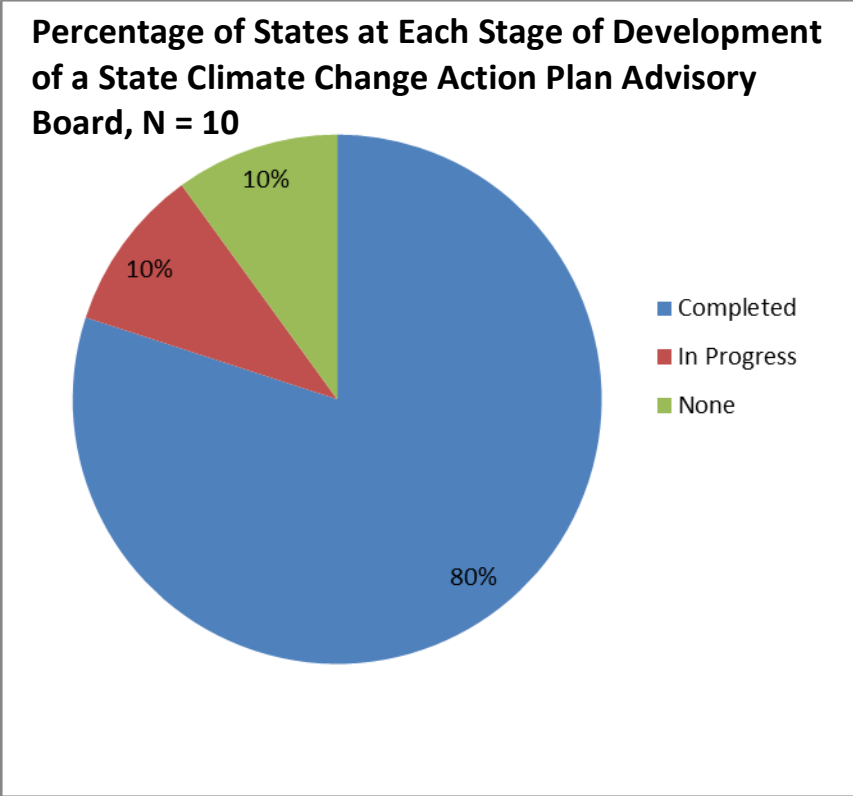
Indicator 19. Health Surveillance Systems Related to Climate Change

Because fewer than half of participants completed this indicator, data are not presented.

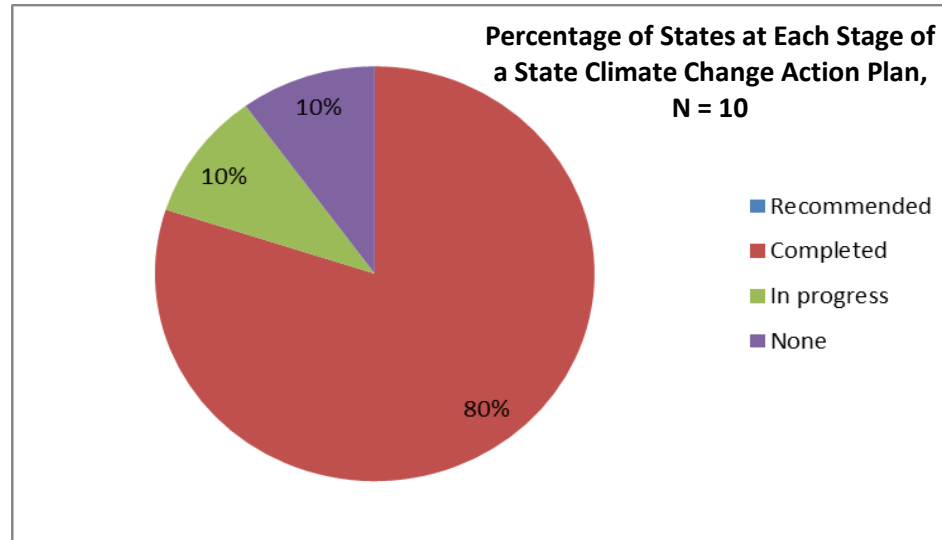
Indicator 20. Public Health Workforce Trained in Climate Change Research, Surveillance, and Adaptation

Because fewer than half of participants completed this indicator, data are not presented.

Indicator 21. Development of a State Climate Change Advisory Board



Indicator 22. State Climate Change Action Plan



Indicator 23. Completion of a Greenhouse Gas Emission Inventory

All states participating in the pilot reported that they have completed a state Greenhouse Gas Emission Inventory.

Indicator 24. Number and Percent of Local Governments Participating in ICLEI

Indicator Measures	DC	IL	NC	FL	WA	WI	MO	CO
No. (%) local governments participating	1 (100)	13 (0.19)	10 (1.54)	28 (5.15)	29 (9.06)	NA	6 (16.12)	NA
% Population of local governments participating	100	26.08	19.95	46.06	82.47	NA	11.22	NA

NA = Data not available

Indicator 25. Percent of Population Living in Cities Participating in the U.S. Conference of US Mayors Climate Protection Agreement

Indicator Measures	DC	IL	NC	FL	WA	WI	MO	CO
No. (%) local governments participating	1 (100)	53 (0.76)	43 (6.64)	78 (16.35)	34 (1.84)	NA	22 (1.60)	17 (27.42)
% Population of local governments participating	100	39.10	29.81	32.14	33.30	NA	21.87	17.58

NA = Data not available