

# MAKING THE GLOBAL LOCAL



RESPONDING  
TO CLIMATE  
CHANGE  
CONCERNS

FROM THE GROUND

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UP

**W**e live on Earth, but we reside, work, and play in local places. Increasingly we speak of—and often worry about—global change, yet we perceive few phenomena in which local actions are directly connected to what happens globally. This is especially true of positive local actions such as recycling wastes or assuring energy-efficient homes and vehicles, as opposed to



such negative, headline-grabbing actions as terrorism.

Perhaps the most widely recognized connection between global environmental processes and local actions is the chain of causality that drives climate change. In this chain of cause and consequences, societal forces such as population, affluence, or technology drive the varied human activities that produce greenhouse gas (GHG) emissions. All three of the above societal forces, for example, drive energy, manufacturing, and transportation needs that ultimately produce the emissions

from electric power plants, industries, and vehicles. GHG emissions then enhance solar radiative forcing of the climate (in which more solar radiation is kept within the Earth's atmosphere than is being reradiated back to space), inducing climate change, which in turn impacts nature and society through such effects as warming, changes in precipitation and storm behavior, and sea-level rise. Finally, the anticipation and experience of effects of climate change encourage a range of human responses to prevent climate change, mitigate it, or adapt to it.

While climate change is truly a global phenomenon, most of the specific actions that lead to climate change and its impacts on nature and society take place at smaller scales. These scales vary geographically more than a billion-fold, from as small an area as a household, farm, or factory to the Earth as a whole. Figure 1 on this page illustrates this range, indicating where major actions take place for each element of the chain of causes and consequences. In this simplified representation, four spatial scales divide the range: global, regional (continental, subcontinental, economic/political unions, large nations), large area (small nations, states, provinces, large basins, 5–10° grids), and local (1° grids, small basins, cities, firms, households).

political unions, and large nations), large area (small nations, states, provinces, large river basins, and areas that constitute 5 to 10 equatorial latitude and longitude degree grids),<sup>1</sup> and local (1 degree grid squares, small river basins, cities, households, farms, firms, and factories).

Action scales vary widely across the causal chain. Driving forces occur at all scales; for example, population serves as a driving force across all four scales. Atmospheric processes tend to fall into large-area or regional categories, while emissions, impacts, and responses are primarily local. It is important to note that although the entire assemblage of processes is commonly referred to as global climate change, only atmospheric concentrations of greenhouse gases that mix rapidly and the resulting radiative forcing are truly global in scale.

### Global Change and Local Places Research Group

In *Global Change and Local Places: Estimating, Understanding and Reducing Greenhouse Gases*, the Association of American Geographers (AAG) Global Change and Local Places (GCLP) Research Group

reports on a five-year study of four local places in the United States.<sup>2</sup> The research group had three main goals: to identify the bundle, or total package, of different greenhouse gas emissions (carbon dioxide, methane, and nitrous oxide) generated by each place over time, the forces that seem to have driven these emissions, and the potentials and limitations for those who live and work in each place to reduce or alter emissions.<sup>3</sup> This article summarizes the Global Change and Local Places Research Group's findings on making a global issue—in this case climate change—local.

### Four Local Places

Each of the local places in the AAG study covers approximately one degree of equatorial latitude and longitude, an area of about 110 kilometers (69 miles) on a side—about the size of the state of Connecticut. An area this size provides a degree of land use diversity at each study site and enables the studies to nest conveniently into the 5 to 10 degree grid often used in climate modeling. The four areas offer varied climatic and socioeconomic conditions, ranging in climate

### Southwestern Kansas

The southwestern Kansas study area lies in the center of the High Plains of the United States and includes six counties with the major towns of Garden City, Dodge City, and Liberal. The region, in the heart of the 1930s dust bowl, is flat, arid, and sparsely populated—in 2000, there were 110,333 people and more than 900,000 cows. Most of these cows are housed in large feedlots, fed by forage crops irrigated from the underground Ogallala Aquifer, and processed in five large meatpacking plants. This industry, plus the major natural gas field underlying the region, constitutes its economic base. The area is distant from major population centers, and its residents tend to view themselves as independent and skeptical of external interference. In recent years, however, Latin American and Asian immigrants seeking jobs in the area's agricultural processing facilities have added some diversity to what was a relatively homogeneous non-immigrant population.

### Northwestern North Carolina

The northwestern North Carolina study area covers 12 counties with 870,246 people in 2000. The Blue Ridge Mountains and the rolling Piedmont—a region of foothills that lie between the mountains and the coastal plain—stretch through the area. Winston-Salem is the major urban center, although there are other small urban areas as well. In the mountains, forestry and tourism form the economic base. The Piedmont's economy includes manufacturing of small-scale furniture, electronics, and textiles as well as tobacco, beef cattle, and poultry production. Using a well-developed transportation network, many rural dwellers commute to work in

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Figure 1. Scale domains of climate change and consequences

	Scale	Driving Forces			Emissions/Sink Changes				Radiative Forcing			Climate Change			Impacts				Responses		
		Population	Affluence	Technological Change	Fossil Fuels	Agriculture	Wastes	Deforestation	Trace Gases	Aerosols	Reflectivity	Temperature	Precipitation	Extreme Events	Ecosystems	Agriculture	Coasts	Health	Mitigation		
																			Sequestration	Prevention	Adaptation
Global		█	█	█				█											█	█	█
Regional	Continental	█	█	█				█											█	█	█
	Sub-continental	█	█	█				█											█	█	█
	Economic/Political Unions	█	█	█				█											█	█	█
	Large Nations	█	█	█				█											█	█	█
Large Area	Small Nations, States, Provinces	█	█	█				█											█	█	█
	Large Basins	█	█	█				█											█	█	█
	5–10° Grids	█	█	█				█											█	█	█
Local	1° Grids	█	█	█				█											█	█	█
	Small Basins	█	█	█				█											█	█	█
	Cities	█	█	█				█											█	█	█
	Firms	█	█	█				█											█	█	█
	Households	█	█	█				█											█	█	█

NOTE: This chart depicts the scale of actions, not necessarily the focus of decision making. The dashed lines indicate occasional consequences or a lower level of confidence.

SOURCE: Association of American Geographers Global Change and Local Places Research Group, *Global Change in Local Places: Estimating, Understanding, and Reducing Greenhouse Gases*. (Cambridge, U.K.: Cambridge University Press, 2003)

urban industries. Population is growing with an influx of new residents, attracted both by job opportunities in a growing regional economy and the pleasant setting, with abundant recreational and scenic attractions.

### Northwestern Ohio

The northwestern Ohio study area sits in the nation's industrial heartland. It contains 23 counties, a major city (Toledo), and in 2000, a population of 1,675,468. Although it contains significant agriculture, the area is dominated economically by a manufacturing economy that has undergone a major restructuring. The expansion of auto parts production and the replacement of older iron, steel, and chemical industrial plants by newer, cleaner plants are the main contributors to this economic change. Socially, the site has a high degree of ethnic and racial diversity, as is the case in most other North American urban-industrial centers. Politically, given its rust-belt history, there is a focus on issues of industrial economic viability and job creation, and these concerns give the area's major employers considerable political influence.

### Central Pennsylvania

The central Pennsylvania study area's five counties lie among the hills and mountains of Appalachia, with a historic dependence on coal mining, logging, and small-scale agriculture. While still a major coal producer, the area also includes State College, the area's largest settlement and home to the main campus of Penn State University. The population of 336,224 (in 2000) now depends largely on the university and associated high-tech manufacturing and service industries for employment. Socially and

politically, there are sharp contrasts between the conservative, traditional cultures of most counties (some hosting Amish and Mennonite enclaves) and the diversity and liberal attitudes of the large university community.

### Three Questions

The study sought answers to three questions: What was the bundle of greenhouse gas emissions generated from each site from 1970 to 1990? What were the

greenhouse gas potential and compared the local data to state and national data. This was accomplished by adapting the U.S. Environmental Protection Agency (EPA) statewide methodology to county-scale analysis by finding credible proxies for missing county-scale data such as a county's consumption of fossil fuels. Projections of emissions were made for 2000, 2010, and 2020 based on widely used socioeconomic forecasts adjusted by the use of local knowledge and insight.

To better understand the driving forces producing GHG emissions, the portion of these emissions used within a study site was allocated to three different user-groups, each responsible for different greenhouse gas-generating processes. The groups were defined as residential, industrial-commercial, and agricultural. Study teams considered variables that were specific to each user-group's consumption patterns to explain the growth or decline in emissions associated with each group. Generally, they followed the E=PAT Kaya identity in identifying variables, where the growth and decline in emissions are

generally a function of population, affluence or economic growth, and production and consumption technologies.<sup>5</sup>

Study teams created two inventories of local emissions to identify how much control the local community had over different portions of the site's emissions bundle—and therefore how much control local people would have in reducing emissions. These inventories consisted of a source or production inventory, and a user or consumption inventory. To estimate local knowledge of global warming issues and the willingness to act to reduce emissions, site teams undertook hands-on investigative work. They sur-

veyed a sample of householders through the mail and by telephone and directly interviewed managers or representatives of major commercial and industrial emitters. In addition, team members studied historic local analogs to greenhouse gas mitigation for insights about local responses to environmental challenges in the past. For example, the study group in Kansas found significant local responses to a problem of groundwater depletion, and in Ohio, they recorded responses to pollution in Lake Erie. Finally, site teams combined local knowledge with information from generic national and international assessments of greenhouse gas reduction potential. With this information, they assessed the potential for future mitigation in each site for conceivable emissions reduction targets.

### Changing Emissions

Emissions at the four sites, using the international baseline year of 1990, were substantially but not dramatically different from global, national, or state emissions. When compared with state, national, and global averages for that year, local emissions differed moderately in the mix of greenhouse gases, somewhat more so in the mix of sources, and considerably in the amount of emissions per person or unit of area. Land use and land cover changes, which in principle reflect economic activities associated with emissions, as well as affecting an area's capacity for absorbing emissions and heat if the changes are significant, accounted for only minor differences in emissions and reflectivity. A major finding, however, was that emissions at the four sites differed greatly both between sites and compared to national trends in emissions between 1970 and 1990. Between 1970 and 1990, GHG emissions in the United States rose by 12 percent; 7 percent in the first decade and 5 percent more in the second. In contrast, emissions at the Kansas site declined in the first decade and rose in the second, declined steadily in both decades in

Ohio, and more than doubled (164 percent increase) in the North Carolina site. Only emissions in central Pennsylvania mirrored the U.S. trajectory, albeit at a rate of increase twice that of the nation as a whole.

Five factors largely determine these differences in sources and rates of emission: whether there is a major source of electricity generation within the site; whether natural resource extraction or production is a significant part of the site's economy; whether the local economy grew or declined; whether such change was reflected in the number of households; and what technologies were in use over time. In a sense, the first two of these factors are random elements, a kind of spatial lottery that places a utility generating plant within the boundaries of a local area or situates primary production (agriculture, forestry, or mining) as a major part of the local economy. The final three, however, are a local expression of the same set of trends found at national and international scales: changes in population, affluence-consumption, and technology.

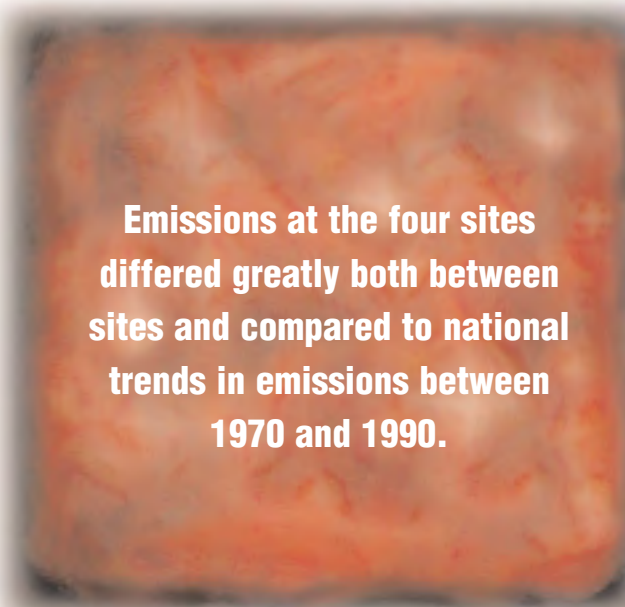
Given these modest differences, are local inventories necessary, or are national inventories and the increasing availability of state inventories—available for 40 U.S. states—sufficient for policy purposes? Site comparisons by category of emission tell us that national and state gas estimates for carbon dioxide in 1990 might suffice to inform local efforts to reduce emissions, although they would overlook local details that could be important. They would not be sufficient for methane or nitrous oxide, and using a national inventory guide to estimate local sources would clearly miss the importance of agriculture in Kansas, biomass burning in North Carolina, particular industrial processes in Ohio, and the preponderance of coal burning in Pennsylvania. But the major contribution of local inventories is in identifying trends in emissions through time. The study's estimates of greenhouse gas emissions from 1970, 1980,

and 1990 constitute a unique data set. This is true not only because they complement national and state estimates (most of which begin with 1990 rather than providing a longer time line), but because local emission trends through time cannot be determined from readily available sources, even though they reveal local causes and consequences that can be important for policymaking.

### Who Is in Charge?

In the best of analytical worlds, it would be possible to take the bundle of greenhouse gas emissions emanating from a study site and simply ask, Who is in charge of the bundle? What portion of total emissions is beyond the control or decisions of the local communities? What portion is under the control of local residents? What portion is a joint decision? A federal regulation that required constructing a coal-fired plant atop a natural gas field in southwestern Kansas, after all, would seem to be outside local control. On the other hand, residents would appear to be responsible for the ten-degree range of heating and cooling they have as they set their home thermostats. And the purchase of an automobile seems to be a good example of a joint decision: local residents choose what kind of car or truck to buy, but their choices are constrained by styles and fuel efficiencies offered that are determined in Japan, Germany, or Detroit and influenced by fuel economy regulations set in Washington.

While the methodology used by the GCLP group reflects international and national practices and in fact sets a new standard for assessments at a local level, it may actually over- or underestimate the bundle of emissions produced directly by the local communities. Some activities and products that contribute to local emissions, while providing income to local people, might also benefit non-locals. Examples of this include natural gas, automobile, and furniture production. Much local consumption of goods, services, and electricity generated else-



Emissions at the four sites differed greatly both between sites and compared to national trends in emissions between 1970 and 1990.



where is associated with emissions that often originate far from the study site. Moreover, a small but perhaps significant portion of the bundle may come from outside sources, as in the case of emissions from vehicles simply passing through the area.

In reality, most of the emissions bundle is almost certainly jointly controlled. History is a major participant. For instance, residents can alter the emissions emanating from their homes but only within a small range governed by who built the structure and how and when they did so. Also, renters in multifamily dwellings have little influence over such issues as insulation. On the other hand, even such external decisions as a distant utility office's choice of location for an electricity generating plant may have been influenced by local desires for economic development or by local demand. Mindful of these variables, the GCLP study focused on that portion of local emissions that might be reduced either through local actions or by local participation in joint multi-scale actions.

### Emissions-Reducing Opportunities

Two standards for emissions reduction served as illustrative goals—the standard agreed to by the United States in Kyoto in 1997 and a more challenging target undertaken by some of the world's cities. The Kyoto agreement specified a 7 percent reduction in 1990 emissions by 2010, while the more stringent target, sometimes referred to as the Toronto goal after the city that adopted it, suggested a 20 percent reduction over a similar period. Actual emission reductions for the four sites in the AAG study would need to be much larger than these percentages, of course, because they would also have to address growth in emissions associated with economic and demographic change that is currently projected for the next two decades. Based on the most plausible of the three emissions projections, overall reductions in emissions

levels of 13 to 37 percent in 2020, depending on the site, would be required to reach a 7 percent reduction target, and 25 to 46 percent in 2020 to reach a 20 percent target. How difficult would it be to achieve such reductions?

Four different analyses identified opportunities to make reductions of this magnitude: an international study conducted by the Intergovernmental Panel for Climate Change (IPCC),<sup>6</sup> U.S. nationwide studies conducted by national laboratories for the Department of Energy,<sup>7</sup> a site-specific analysis using the methodology of the Cities for Climate Protection Program of the International Council of Local Environmental Initiatives (ICLEI),<sup>8</sup> and a local knowledge analysis by study site teams.<sup>9</sup> These studies differed in their technological and economic optimism and in their assumptions about political will, which led to different estimates of potentials from particular technology applications. Table 1 on this page summarizes these different perspectives. For instance, emitters in the energy production sector are among the major emitters

in the GCLP and Department of Energy studies but were not considered in the ICLEI analyses; buildings-related emissions are a major issue in the ICLEI studies but not in the GCLP studies. Delving deeper into the four studies further illustrates the different perspectives. For example, the ICLEI analysis found that if two of the GCLP study areas applied known emissions reduction strategies, emphasizing energy efficiency improvement, emissions resulting from building and transportation energy use would drop significantly by 2020—20 to 50 percent for buildings and 50 percent for transportation. In contrast, the local area study teams were less optimistic about such prospects. The Department of Energy studies were prepared by scientists and engineers who are optimistic about technology, as were the IPCC studies. The Department of Energy conclusions, however, were seemingly pessimistic about prospects for strong governmental initiatives to mandate or encourage the adoption of such technology. Subsequent developments have borne out their cau-

tion; in recent years the United States has refused to accede to even the mild commitments of the Kyoto Protocol.

For the immediate future, then, the potentials for significant reductions in GHG emissions in the United States will likely depend on the decentralized actions of state, local, and corporate entities. Because the study sites offer a glimpse of what might happen on the local level, the next question that begs answering is whether local communities have the capacity—or the will—to take on such a challenge.

### Can Local Places Reduce GHGs?

There are many technological possibilities to address major sources of greenhouse gases in the four study areas. Solutions include substituting natural gas for coal in electricity generating plants in North Carolina and Kansas, energy efficiency improvements in industrial plants in Pennsylvania and Ohio, improvements in transportation efficiencies in North Carolina, Ohio, and Kansas, and reducing methane emissions from cattle in Kansas. More specifically, opportunities include benefits from biomass burning (in place of fossil fuels consumption for industrial production) in North Carolina<sup>10</sup> and improving the efficiency of natural gas pipeline compressors in Kansas. In Ohio, shifting the industrial mix toward “cleaner” production activities and changing locational patterns to reduce distances to work were found as significant opportunities. Other options that address larger challenges for sustainable development in the localities can also lead to emissions reductions, such as growth management in North Carolina, irriga-

tion efficiency in Kansas, sprawl limitation in Ohio, and diversification of the economy in Pennsylvania.

### Willingness to Change

Local people at all four sites have significant opportunities to reduce greenhouse gas emissions. But how willing are localities to act upon them? How willing and able are local people to reduce emissions? Clues may be found in surveys of major emitters and households, an analysis of case studies of analogous response to a major environ-

describe their industry or activity and were asked about their knowledge and concern for global warming. Other questions involved their understanding of specific opportunities for emissions reduction, and where emissions generating and reduction decisions were made.

Those who were best informed about climate change issues and potential regulations associated with compliance with the Kyoto Protocol were the industrial emitters. Concerns were generally greatest in Ohio, because of the larger numbers of industrial producers there, and least in southwestern Kansas. But even for the most informed, there was little connection between global warming and the specifics of their local activities. At all of the four sites, local industries tended to focus on air pollution concerns rather than on climate change as affecting their activities. Perceived emission reduction opportunities differed considerably between the four sites, but for the most part they involved some form of energy efficiency improvement, and all those involved in electricity generation recognized the benefits of switching fuels and upgrading technologies. There was a wide-

spread preference for state and local regulatory oversight rather than by the federal government, because state and local regulators were seen as being more trustworthy and understanding of local problems and capabilities.

In most cases, however, the decisions about applications of many of the technological opportunities could not be made by local managers. Although emissions abatement is primarily a local activity, it takes place within the context of larger-scale government and corporate policies. Few of the needed larger-

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Sector	IPCC (Global)	DOE (National)	ICLEI (Local)	GCLP (Local)
Buildings	L	M-S	L	S
Industry	M-L	M	M-L	S-L
Transportation	M	M	M-L	M
Agriculture	M	N/A	N/A	L-N
Waste	S	N/A	S-L	N/A
Energy	M	L-M	N/A	L

NOTE: Opportunities were designated as large (L), moderate (M), small (S), negligible (N), not estimated (N/A), or are recorded as a range (For example, M-L indicates that opportunities ranged from medium to large). Target date for reductions set as 2020.

SOURCES: IPCC: Intergovernmental Panel on Climate Change, *Climate Change 2001: Mitigation* (Cambridge, U.K.: Cambridge University Press, 2001); DOE: M. A. Brown and M. Levine 1997, *Scenarios of U. S. Carbon Reductions: Potential Impacts of Energy-Efficient and Low-Carbon Technologies by 2010 and Beyond*, ORNL/CON-444; National Laboratory Directors 2001, *Technology Opportunities to Reduce U.S. Greenhouse Gas Emissions*, ORNL/FPO-01/2, accessible via [http://www.ornl.gov/climate\\_change](http://www.ornl.gov/climate_change); and Interlaboratory Working Group 2000, *Scenarios for a Clean Energy Future*, ORNL/CON-476; ICLEI: Regarding the international program, see <http://www.iclei.org/co2/>; for the U.S. program, see <http://www.iclei.org/us/ccp/>; and GCLP: Association of American Geographers Global Change and Local Places Research Group, *Global Change in Local Places: Estimating, Understanding, and Reducing Greenhouse Gases* (Cambridge, U.K.: Cambridge University Press, 2003).

scale government and corporate policies that might enable local action are currently in place in the four study areas. Exceptions included Toledo's membership in the Cities for Climate Protection program and the important local roles of BP-Amoco and Sun Oil, corporations committed to emissions reduction.

Types of incentives or mandates that would make a difference include tax credits for emissions-reducing investments, fees for carbon emissions, mandatory emissions limitations, and more stringent vehicle emissions standards. One combination of mandates and incentives would be an emissions cap defined in terms of permits to emit, allowing permits to be traded. In other words, companies that exceed their level of allowable emissions could purchase permits from companies that produce fewer emissions. In such a scenario, another incentive would be to allow U.S. emitters to receive credit for emissions reductions either through their own operations or by reducing emissions (possibly including biomass sequestration) elsewhere in the world.

A sample of householders was surveyed at each site to gauge local levels of public concern. The first survey was carried out in 1997, when global warming was beginning to emerge as a subject of public interest. Global warming at that time ranked low among householders' concerns. This finding seems to contradict national opinion polls of the time that showed higher levels of concern and willingness to reduce emissions, even at some cost. Opportunities for households to reduce emissions were generally perceived by householders as being mainly in transportation, space heating, and electricity use. But given the low level of concern,

local residents were often unaware of opportunities for emission reduction, and there was little evidence of an inclination to act upon them once they were pointed out. An abbreviated survey was later undertaken in 2000, finding little change in the four local areas.

If, however, global warming and climate change become a greater public concern at the local scale in the United States, what might be the local response? Looking at the case studies that the site teams compiled is instructive here. These

**If global warming and climate change become a greater public concern at the local scale in the United States, what might be the local response?**

case studies, of an historic analog, show an effective local response to a major environmental problem in each area. In Kansas, researchers noted the local community's response to declining irrigation water levels in the Ogallala Aquifer. The other cases involved watershed protection in North Carolina, an effort to clean up pollution in Lake Erie, and air pollution abatement in Pennsylvania. These studies looked at the elements of success in each case and estimated the capacity and propensity of the local place to respond to global warming. Given the success of local participation in the

issues, the analogs suggested that if localities become seriously concerned about global warming and aware of links to their own activities, they will be able to undertake major actions. For example, in Kansas the farming community widely adopted water conservation practices. In North Carolina, improvements were made in water quantity and quality, and the cleanup of Lake Erie in Ohio is an ongoing effort.

Finally, the GCLP study examined real-time efforts in support of emissions reduction in the study sites and the relationship of study site teams to them. In northwestern Ohio, local branches of industrial firms that have recognized global warming as a real issue undertook major emissions reducing actions and encouraged the city of Toledo to join the International Council on Local Environmental Initiatives's Cities for Climate Protection Program. In North Carolina, the GCLP study area team, with EPA funding, prepared an *Action Plan for Reducing North Carolina's Greenhouse Gas Emissions*.<sup>11</sup> At the southwestern Kansas site, research findings en-

couraged members of the state's congressional delegation to explore carbon sequestration in the soils of the area's agricultural fields.

#### **Encouraging Local Initiatives**

Given the assessment of both the capacity and willingness to undertake emissions reduction, it seems that significant emissions reductions, on the order of the changes required to meet either of the hypothetical targets, will be difficult for these four local places on their own. Between now and 2020, emissions will continue to grow at all of the sites, as

well as for the country as a whole. Meeting even the modest illustrative target of Kyoto appears to be a major challenge for local places. To tackle this challenge would require at least three things:

- greater control for local communities over a significant portion of their emissions;
- local understanding and will derived from a shared belief that emissions reduction is in the interest of the area; and
- access for the community to technological and institutional means that are not currently available.

At the time of the study, most of the political or economic decisionmaking authority was beyond the scope of local residents and managers. The community's awareness of global warming was low in 1997 and only slightly higher in 2000. Even well-informed major emitters were, for the most part, reluctant or unable to undertake reduction actions on their own. At several sites, needed technologies for reduction were not available. At all sites the needed institutional framework of incentives and mandates is still absent. But it is also apparent, looking at the study of analogs and the community experience of Toledo, that a combination of global and local actions can be very effective under certain conditions.

#### **Next Steps**

Looking to the future, at least four actions would help to encourage local action to reduce greenhouse emissions. The growing evidence of impacts from global climate change, negative and positive, needs to be presented to the local community in a way that vulnerabilities are made clear. One starting point was the recent U.S. assessment *Climate Change*

*Impacts on the United States: The Potential Consequences of Climate Variability and Change*,<sup>12</sup> which identifies impacts relevant to the GCLP local sites such as increased drying of agricultural and ranch lands in southwestern Kansas and lowered Great Lakes levels for northwestern Ohio. But more can be done to involve local stakeholders in assessing their own vulnerabilities to climate change. More can be done as well to facilitate local community understanding of local expressions of climatic variability and of physical and

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biological changes due to climate change that are already under way.

GHG emissions reduction also needs to be linked to economic and environmental benefits to the local area, directly or indirectly. Most of the cities that have joined the Cities for Climate Protection campaign (see the box on page 22) have done so because of such local concerns as air pollution, energy costs, traffic, and urban sprawl. Cities have also signed on to the campaign to be more competitive for business and industrial growth—members of Cities for Climate Protection can claim that they are cleaner and more progressive than non-members.

Local innovations need to be encouraged by combining broader incentives and technical assistance with a high degree of local participation in designing and implementing strategies. Biomass burning in North Carolina or feedlot diet improvement in southwestern Kansas, as examples, are the result of local innovation.

Finally, technology improvements that are appropriate to local conditions need to be developed without significantly increasing costs or inconvenience. Ideally, these improvements would provide local opportunities—such as the potential for sequestering carbon in the prairie and plains soils of southwestern Kansas—to reduce net emissions from the area.

#### **Thinking and Acting Globally and Locally**

Simply stated, the Global Change in Local Places project shows that the beguiling slogan "Think globally and act locally" is insufficient to deal with climate change and its causes and consequences. Climate change is a global phenomenon, but global or even

national "thinking" averages together too many distinctive local trajectories of greenhouse gas emissions and their driving forces, missing opportunities to reduce emissions and making local actions less specific. But local "thinking" is also insufficient for action because, for the most part, decisions about major emissions-reducing actions are made far from the local community. The GCLP experience suggests that thinking and acting both globally and locally involves at least three imperatives to succeed:

- *Make the global local.* To be able to think globally in a local place, the global must first be made local. To make such



global knowledge local, locally based and trusted sources such as the collaborating GCLP regional institutions—with

support from external information sources—can communicate current scientific understanding, identify local

sources and responsibilities for greenhouse gas emissions, and suggest local sectors and places vulnerable to climate change. Local studies therefore become important as a way to transmit information and understanding. They then create support for national and state actions, and enable informed local action.<sup>13</sup>

• *Look beyond the local.* Local places must also think globally. Local studies, knowledge, and “thinking” are important, but understanding how and why a place creates its bundle of greenhouse gases requires an appreciation of driving forces beyond the local. The driving forces of local economic development, the associated increases in the number of households, and the technologies in use vary widely between sites. These driving forces are proximate, however, and are motivated by larger regional, national, and global processes related to industrial and economic organization. In addition, they are affected by social change in the workplace, household structure, and associated norms and values. The specifics of energy supply and price, environmental and land use regulation, and consumer and market demand for products that encapsulate emissions in their production and consumption are also factors. Leaders in local areas need to be fully aware of processes that operate at a larger scale. In this way, local communities can realize potentials that such processes support and avoid disillusionment from efforts that they undermine.

• *Act globally to act locally.* Reducing emissions is primarily rooted in local activities, but these actions take place within a context of corporate policy and regional, national, and global government. For local places to act to reduce their bundle of greenhouse gas emissions, they must have a desire to act, and they must have some control over a significant portion of their emissions. Most importantly, they must have access to the techno-

logical and institutional means of doing so. This requires enabling actions at larger scales—from market forces and corporate policies to actions of states, nations, and international agreements—that encourage localities to take action. The current framework of incentives and mandates does not encourage such local action, and the portfolio of available technological opportunities is often a poor match with the needs of specific places.

Especially in this time when progress with greenhouse gas emission reduction through international agreements has been so disappointing,<sup>14</sup> localized action may be the most promising path toward addressing a global challenge if its potential can be realized. Recent actions by U.S. states, localities, corporations, and congregations offer some reasons to be encouraged (see the box on page 22). But the GCLP project strongly suggests that this prospect will remain largely a tantalizing dream unless government and business leaders at national and global scales are willing to give local communities more control over their activities, to develop more persuasive rewards for emission reduction initiatives, and to give communities technology options and other tools suited for local conditions.

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#### NOTES

1. 5 to 10 equatorial latitude and longitude degree grids are commonly used in global climate models.
2. Association of American Geographers Global Change and Local Places Research Group, *Global Change in Local Places: Estimating, Understanding, and Reducing Greenhouse Gases* (Cambridge, U.K.: Cambridge University Press, forthcoming). We are truly indebted to the NASA's Office of Earth Science for providing research support, to the book's lead editor, Ronald Abler, and to our fellow authors: David P. Angel, Clark University; Samuel A. Aryeetey-Attoh, University of Toledo;

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3. Excluded from the GCLP schema were local impacts of global climate change. At the time the project began, capabilities to produce reliable impact estimates for small areas did not exist. Were a similar project being designed today, of course, impact estimates would most likely be included as a fourth module.

4. These were: Kansas: the Department of Geography at Kansas State University; North Carolina: the Department of Geography and Planning at Appalachian State College; Ohio: the Department of Geography and Planning at the University of Toledo; and Pennsylvania: the Department of Geography and the Center for Integrated Regional Assessment at Pennsylvania State University.

5. Y. Kaya, “Impact of Carbon Dioxide Emission Control on GNP Growth: Interpretation of Proposed Scenarios” (paper presented to the IPCC Energy and Industry Subgroup, Response Strategies Subgroup, Paris (mimeo), 1990).

6. Intergovernmental Panel on Climate Change, *Climate Change 2001: Mitigation* (Cambridge, U.K.: Cambridge University Press, 2001).

7. M. A. Brown and M. Levine 1997, *Scenarios of U.S. Carbon Reductions: Potential Impacts of Energy-Efficient and Low-Carbon Technologies by 2010 and Beyond*, ORNL/CON-444; National Laboratory Directors 2001, *Technology Opportunities to Reduce U.S. Greenhouse Gas Emissions*, ORNL/FPO-01/2, accessible via [http://www.ornl.gov/climate\\_change](http://www.ornl.gov/climate_change); and Interlaboratory Working Group 2000, *Scenarios for a Clean Energy Future*, ORNL/CON-476.

8. Regarding the international program, see <http://www.iclei.org/co2/>; for the U.S. program, see <http://www.iclei.org/us/ccp/>.

9. Association of American Geographers, note 2 above.

10. N. G. Lineback et al., “Industrial Greenhouse Gas Emissions: Does CO<sub>2</sub> from Burning Biomass Really Matter?” *Climate Research*, 13, no. 3 (1999): 221–9.

11. Appalachian State University Department of Geography and Planning, *North Carolina's Sensible Greenhouse Gas Reduction Strategies* (Boone, N.C., 1999).

12. National Assessment Synthesis Team, *Climate Change Impacts on the United States: The Potential Consequences of Climate Variability and Change*, U.S. Global Change Research Program (Washington, D.C., 2000).

13. The GCLP study groups are listed in note 4, above.

14. J. G. Speth, “A New Green Regime: Attacking the Root Causes of Global Environmental Deterioration,” *Environment*, September 2002, 16–25.

## Recent State, Corporate, and Local Actions to Reduce GHG Emissions

The United States is unique among the signatories of the Framework Convention on Climate Change in not seeking ratification of the Kyoto Protocol to reduce greenhouse gas (GHG) emissions. However, U.S. states, cities, corporations, and congregations, enabled or encouraged by their global and national counterparts, are moving to reduce GHGs, often by a greater degree than specified by the Kyoto quotas.<sup>1</sup>

In August 2001, the New England governors and eastern Canadian premiers adopted the Regional Climate Change Action Plan to jointly reduce regional GHG emissions to 1990 levels by 2010 and 10 percent below that by 2020. To do so, New Hampshire declared carbon dioxide a pollutant and will seek to regulate emissions for its power plants. Massachusetts capped carbon dioxide emissions of its six major emitting power plants. Other states have applied similar measures. New Jersey adopted a 2005 goal to reduce GHG emissions to 3.5 percent below 1990 levels, and Oregon has pioneered mandatory offsets for 17 percent of electric utility emissions. Especially noteworthy, California will now regulate carbon dioxide emissions from automobile exhaust, and New York state is considering a similar policy.<sup>2</sup>

Looking more at the local scale, it is impressive to note that 138 U.S. cities

and counties, accounting for 16 percent of the U.S. population and about 16 percent of GHG emissions, participate in International Council for Local Environmental Initiatives's Cities for Climate Protection Campaign. Together they have already reduced their emissions by an estimated 10.4 million tons.<sup>3</sup> To date, 38 cities have completed the second of five milestones—setting an emissions target—with the most common target being a 20 percent reduction by 2010 below their 1990 emissions.

At least 38 major corporations have adopted targets for energy and/or emissions reduction, and a number of companies, such as BP-Amoco Oil (which has a target of reducing corporate emissions by 10 percent by 2010), are currently conducting intra-corporation emissions “cap and trade” programs.<sup>4</sup> In addition, 18 State Councils of Churches are participating in an Interfaith Global Climate Change Campaign.<sup>5</sup> In Maine, for example, individuals and families create carbon dioxide savings accounts equivalent to at least a 7 percent (Kyoto) reduction in 1990 levels of personal and household emissions.<sup>6</sup> These “bottom-up” initiatives not only act locally and globally but also create the interest and involvement that presage needed political change.

1. Regional, state, and corporate examples cited here are taken from Pew Center on Global Climate Change, “Climate Change Activities in the United States” (Arlington, VA, 2002), accessible via [http://www.pewclimate.org/projects/us\\_activities.pdf](http://www.pewclimate.org/projects/us_activities.pdf) (last accessed 21 February 2003).

2. Pew Center on Global Climate Change, note 1 above.

3. Susan Ode, Director of Outreach for the U.S. Office of Cities for Climate Protection, International Council for Local Environmental Initiatives, personal communication with authors, Berkeley, CA, 21 October 2002; International Council for Local Environmental Initiatives, U.S. Office, *U.S. CCP Milestone Progress*, 16 October 2002.

4. See the Interfaith Global Climate Change Campaigns web site, accessible via <http://www.webofcreation.org/climate.html>.

5. Pew Center on Global Climate Change, note 1 above.

6. See the Maine Interfaith Climate Change Initiative web site, accessible via <http://www.maine-councilofchurches.org/climate2.html>.

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