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LOCAL GOVERNMENTS FEEL THE HEAT: PRINCIPLES FOR LOCAL GOVERNMENT ADAPTATION TO THE IMPACTS OF CLIMATE CHANGE

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Sea level rise, storm surges, increased heat, more prevalent and intense wildfires, and other projected climate change impacts threaten human health, social welfare, and public and private property. Because local governments bear direct responsibility for much of the public safety, land-use planning, infrastructure, emergency response, and public health protection programs upon which all of us rely, they will be on the front lines of addressing climate change impacts. Impacts of climate change will alter the ways in which local governments address their traditional responsibilities.

This Article proposes a set of governance principles to help local governments meet the challenge of climate change. I recommend that local governments employ seven broad principles. First, local governments should understand the physical and social vulnerabilities and barriers to resilience within and among communities. Second, it is important not to wait for complete understanding, the perfect political moment, or an infusion of resources before acting. Third, local governments should use evaluation tools with public participation components, such as environmental impact assessment and scenario planning, to plan for adaptation to future conditions. Fourth, they should understand and use land-use planning, emergency response, and other available local government tools and responsibilities. Fifth, it is crucial for local decision-makers to understand the state and federal legal and policy context. Sixth, local governments should consider how other local government initiatives will help or hinder adaptation to climate change impacts. And finally, they should take actions to reduce populations' vulnerability to stressors, with

1. Evan Frankel Professor of Policy and Practice; Co-Executive Director, Emmett Institute on Climate Change and the Environment, UCLA School of Law. The author is grateful to Celeste Hammond and Virginia Harding for allowing him to participate in this symposium; to Megan Herzog for her helpful comments on a draft of this Article; and to the editors of THE JOHN MARSHALL LAW REVIEW.

a special focus on those who are already among the most vulnerable.

This set of principles serves three primary purposes. First, these principles are designed to further the adaptation goals of reducing exposure and sensitivity to climate change-related risks, building adaptive capacity, and ensuring equity among communities with different resources.² Second, the principles attempt to integrate valuable knowledge that typically under-informs policy, including information about local adaptation planning processes that focus on assessing physical and social vulnerability and risk, as well as research on the role of existing legal regimes in constraining or assisting adaptation efforts. And third, the principles should help local governments allocate limited resources and navigate complex legal, social, and physical dynamics.

Local governments will face myriad challenges, some of which may be novel or at least idiosyncratic to a particular local government's specific location, governance structure, or population. It is, of course, impossible to articulate principles that will apply to all possible situations. The seven principles below are intended merely as guidance—along with citations to further resources—as local governments begin to grapple seriously with climate change adaptation.³

I. UNDERSTAND THE PHYSICAL AND SOCIOECONOMIC VULNERABILITIES AND BARRIERS TO RESILIENCE WITHIN AND AMONG COMMUNITIES

Climate change will affect all of us. But some people, communities, and infrastructures are more vulnerable or less resilient than others. Exposure and sensitivity to the risk of specific future climate impacts are higher in some places than in others.⁴ Lack of resilience, or the capacity to cope with climate-

2. See National Research Council, *Adapting to the Impacts of Climate Change* 29 (2010), available at

http://www.nap.edu/catalog.php?record_id=12783 (noting goals of reducing exposure and sensitivity and building adaptive capacity); Alice Kaswan, *Domestic Climate Change Adaptation and Equity*, 42 ENVTL. L. REP. NEWS & ANALYSIS 11125 (2012) (highlighting concerns about equity in climate change adaptation).

3. This work draws on, amplifies, and adds to other sets of adaptation principles—not specifically focused on local governments—put forward by Robin Craig, Alice Kaswan, and other legal scholars (e.g., Robin Kundis Craig, *“Stationarity is Dead” – Long Live Transformation: Five Principles for Climate Change Adaptation Law*, 34 HARV. ENVTL. L. REV. 9 (2010); Kaswan, *supra* note 2), as well as other work from researchers in the social and natural sciences and from government officials. I give short shrift—deliberately—to some of the fine recommendations made in those other articles, not because I disagree with the recommendations, but in order to focus here on principles that are uniquely or especially relevant to local government activities.

4. See Gary Yohe & Richard S.J. Tol, *Indicators for Social and Economic*

related shocks,⁵ may arise from limited resources or other pre-existing socioeconomic or physical vulnerabilities. Conversely, some areas already have tremendous adaptive capacity, or will have new opportunities arise from changed conditions. Local governments should understand the current conditions and the places and people that are likely to be harmed or helped by probable changes within their jurisdictions. This understanding will be essential to sound planning, and will also enable government to reduce inequities among affected communities.⁶ The goals of reducing exposure and sensitivity, building adaptive capacity, and ensuring equity all demand a basic understanding of these conditions. Thus, proper adaptation planning by local governments will be essential to meeting these goals.

Physical vulnerability largely drives the need for climate adaptation. Local governments are likely to face challenges to water resources, water quality, ecosystems, energy, agriculture, and public health. Sea-level rise and related storm-surge risk, wildfire risk, and increased heat in urban areas are all likely consequences of climate change impacts.⁷ A community cannot respond effectively to change without assessing how these challenges are likely to affect it.

To take just one example, in coastal areas, communities are likely to experience increased risk of flooding and inundation, as a result of both gradual sea-level rise and storm surges that may be more frequent or more intense.⁸ In an important sense, these

Coping Capacity - Moving Toward a Working Definition of Adaptive Capacity, 12 GLOBAL ENVTL. CHANGE 25, 26-27 (2002); Alice Kaswan, *Climate Adaptation and Land-Use Governance: The Vertical Axis*, COLUM. J. ENVTL. L. (forthcoming 2014) at 11 (concisely explaining “exposure” and “sensitivity”); See National Research Council, *Adapting to the Impacts of Climate Change* 29 (explaining “sensitivity” as “the underlying social, cultural, economic, geographic, ecological, and other factors that interact with exposures to determine the magnitude and extent of impacts”).

5. This term is closely linked to, and often used interchangeably with, the term “adaptive capacity” in the scientific literature. This article will use the terms interchangeably. See *id.* See also IPCC WGII AR5 Glossary 23, available at http://ipcc-wg2.gov/AR5/images/uploads/WGIAR5-Glossary_FGD.pdf (defining “resilience as “[t]he capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation”); *id.* at 2 (defining “adaptive capacity” as “[t]he ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences”).

6. See, e.g., Kaswan, *supra* note 2 (providing an insightful and thorough analysis of the role of reducing inequity in climate change adaptation).

7. Thomas M. Gremillion, *Setting the Foundation: Climate Change Adaptation at the Local Level*, 41 ENVTL. L. 1221, 1239-43 (2011).

8. See Andrew D. Ashton, Jeffrey P. Donnell, & Rob L. Evans, *A Discussion of the Potential Impacts of Climate Change on the Shorelines of the*

risks are similar to existing risks: our coastlines have always been dynamic systems, characterized by stochastic events that are in tension with long-term human settlement.⁹ But climate change will alter the parameters on which predictions about coastal change have long rested, just as the changing climate alters the assumption that our natural systems generally will continue in the mold of past experience.¹⁰ These changes will have real-world consequences. Contaminated sites inundated with water may—as occurred after Hurricane Katrina—release hazardous substances in ways that challenge local governments' planning and emergency response resources.¹¹ Stormwater and wastewater management systems may become overwhelmed and ineffective.¹² Fresh water may become saline as seawater intrudes upon the water table and overwhelms estuaries.¹³ Coastal infrastructure such as ports, airports, and ground transportation networks will have to cope with higher sea level than was assumed when the infrastructure was designed.¹⁴ The health and safety impacts of flooding will impact emergency response resources and other critical facilities.¹⁵ Coastal change in areas with existing development will impact ecosystems and recreational resources as rising waters leave nowhere for beaches, wetlands, and other systems to migrate.¹⁶ And residential and commercial building stock and surrounding properties will have to either be protected from the changing coastal dynamics—at a cost to other resources—or adapt or even retreat if protection is impossible, infeasible, or unwise.¹⁷

These physical impacts drive the necessity for climate change adaptation in crucial ways. At the same time, however, physical exposure and sensitivity to climate change impacts exist in a social context. Social vulnerability—the “susceptibility of a given

Northeastern USA, 13 MITIG. ADAPT. STRAT. GLOBAL CHANGE 719, 724-27 (2008); Keqi Zhang, John Dittmar, Michael Ross, & Chris Bergh, *Assessment of Sea Level Rise Impacts on Human Population and Real Property in the Florida Keys*, 107 CLIMATIC CHANGE 129, 130 (2011) (citing multiple sources).

9. See Ashton et al., *supra* note 8, at 719-20.

10. See Robin Kundis Craig, *supra* note 3, at 15-16 (discussing literature on the “death” of “stationarity” —the “idea that natural systems fluctuate within an unchanging envelope of variability”—as a result of climate change).

11. Steven M. Presley, et al., *Assessment of Pathogens and Toxicants in New Orleans, LA Following Hurricane Katrina*, 40 ENVIRON. SCI. TECH. 468, 468-74 (2006); Matthew Heberger et al., *The Impacts of Sea-Level Rise on the California Coast*, (Cal. Climate Change Ctr. 2009), available at http://www.pacinst.org/reports/sea_level_rise/report.pdf.

12. Heberger et al., *supra* note 11, at 20.

13. *Id.* at 80-81.

14. *Id.* at 54-65.

15. Shuang-Ye Wu, Brent Yarnal, & Ann Fisher, *Vulnerability of Coastal Communities to Sea-Level Rise: A Case Study of Cape May County, New Jersey, USA*, 22 CLIMATE RES. 255, 266 (2002); Heberger et al., *supra* note 11, at 51-52.

16. Heberger et al., *supra* note 11, at 65-73.

17. *Id.* at 74-79.

population to harm from exposure to a hazard, directly affecting its ability to prepare for, respond to, and recover” from physical change¹⁸—interacts with physical exposure and sensitivity, and in many cases will be the crucial driver of communities’ capacity to avoid harm, to bounce back from disaster, and to avoid inequitable outcomes from climate change impacts.¹⁹ The most vulnerable tend to be poor, elderly, members of racial minority groups, recent immigrants, or members of communities dependent upon resources that are themselves physically vulnerable.²⁰ For instance, these vulnerable people and communities may not be able to afford to live in areas where vulnerability is lower, or may have less access to basic services, such as transportation or healthcare, or may be in tenuous financial situations where an interruption of their living or working conditions catapults them into poverty. On the other hand, in some cases physical or social dynamics will even enable some communities to benefit from climate change impacts, while social vulnerability may hamper other communities from taking advantage of changed conditions.²¹

Without assessment of these vulnerabilities and potential benefits, followed by development of strategies to address the vulnerabilities and to implement changes, local governments’ attempts to plan for a changed and dynamic future are unlikely to succeed. Many resources are available to local governments to assist them in assessing vulnerability.²² Local governments are increasing their use of formal vulnerability assessments.²³ These assessments typically involve several sequenced steps. First, a community will gain an understanding of the particular climate change impacts to which it is exposed (for example: increased heat,

18. Heather Cooley et al., *Social Vulnerability to Climate Change in California*, (Cal. Climate Change Ctr. 2012), available at <http://ucciee.org/downloads/Social%20Vulnerability%20to%20Climate%20Change%20in%20California.pdf> (citing SUSAN L. CUTTER ET AL., *SOCIAL VULNERABILITY TO CLIMATE VARIABILITY HAZARDS: A REVIEW OF THE LITERATURE* 1-2 (2009), available at http://adapt.oxfamamerica.org/?utm_source=redirect&utm_medium=web&utm_campaign=USROSVM).

19. See Kaswan, *supra* note 2 at 11126; Robert R.M. Verchick, *Disaster Justice: The Geography of Human Capability*, 23 DUKE ENVTL. L. & POL’Y F. 23, 38-45 (2012); CUTTER ET AL., *supra* note 18, at 1-2.

20. Kaswan, *supra* note 2, at 11126; Verchick, *supra* note 19, at 23-24; CUTTER ET AL., *supra* note 18, at 1-2.

21. See generally J.B. Ruhl, *The Political Economy of Climate Change Winners*, 97 MINN. L. REV. 206 (2012); Robin Kundis Craig, *The Social and Cultural Aspects of Climate Change Winners*, 97 MINN. L. REV. 1416 (2012).

22. See, e.g., *California Climate Adaptation Planning Guide: Planning for Adaptive Communities*, CAL. EMERGENCY MGMT. AGENCY, (2012), available at http://resources.ca.gov/climate_adaptation/local_government/adaptation_planning_guide.html.

23. See, e.g., *id.* at 13 (noting that the Adaptation Planning Guide was pilot-tested in seven California communities).

inundation, or wildfires). Second, it will measure or model sensitivity to these risks: which people, structures, or functions will the exposure affect, and how? Third, it will learn how exposures impact the people, structures, and functions. Fourth, what resources it currently uses, or has in place to deploy, to address the impacts. And finally, the community should determine how likely the impacts are to materialize and how quickly they will occur.²⁴

Under typical adaptation planning models, these steps are prerequisites to, and followed by, an assessment of community needs and priorities, and the selection and implementation of specific adaptation strategies.²⁵ Thus, in addition to helping communities to understand what the impacts of change may be, these tools shape the responses to climate change impacts.²⁶ While many impacts may not be precisely predictable, and while local governments' planning resources may be limited, even a broad understanding of place-specific physical and social vulnerability can be very useful for communities as they plan for the future.

II. DON'T WAIT FOR A COMPLETE UNDERSTANDING, THE PERFECT POLITICAL MOMENT, OR AN INFUSION OF RESOURCES BEFORE ACTING

Planning for climate change impacts is hard to do. Limited understanding of impacts and vulnerability, limited resources, conflicting priorities, political concerns, anticipated reliance on private, state, or federal solutions, and inertia make it difficult for local governments to plan ahead and to prioritize.²⁷ As a result, many communities are waiting instead of acting.²⁸ But the costs—social, physical, and economic—of waiting for disaster to strike and then attempting to address harms after the fact will likely outstrip dramatically the costs of acting now, if local governments are intelligent in their planning and resource allocation. In short, paralysis is not a strategically viable option.

Clearly, planning for climate change is characterized by serious uncertainties.²⁹ But this is not unusual. Many policy decisions rely on scientific information that fails to completely answer policy questions, and is characterized by uncertainty. Each local government decision regarding climate change needs to take into account both scientific uncertainty and the balancing of the risk of harm with other risks and needs.

24. *Id.* at 16-22, 26-30.

25. *Id.* at 14-15.

26. *See id.* at 23-25.

27. *See, e.g.,* Susanne C. Moser & Julia A. Ekstrom, *A Framework to Diagnose Barriers to Climate Change Adaptation*, 107 *PROC. OF THE NAT'L ACADEMY OF SCI.* 22026, 22026-27 (2010); James D. Ford et al., 106 *CLIMATIC CHANGE* 327, 333-334 (2011).

28. *See* Ford et al, *supra* note 27, at 334-35 (noting widespread inaction).

29. *See, e.g.,* Zhang et al., *supra* note 8, at 134 (noting significant uncertainties in sea-level rise predictions).

Lack of predictability is especially true under changing climatic conditions. For example, scientific modeling and measuring can help us to predict, with some level of confidence that sea levels are likely to rise by a certain number of centimeters in a certain area within the next century. On top of that, economic theory and modeling might be able to tell us the likely economic consequences of unchecked sea-level rise, or of undertaking any particular response. And scientists might be able to model the impact of that sea-level rise on local ecosystems or on properties at the block or parcel level. But each of these inquiries will provide only an estimate, subject to scientific uncertainty, and thus cannot tell us exactly what the consequences of any given response (or no response) will be.

Further, even if the future impacts of climate change were all but certain, the outputs of science cannot tell us how best to address the situation. We must apply our values and deploy our political institutions to figure that out, since such questions are ultimately policy questions that transcend science.³⁰ For example, there is no single correct answer to the question of how stringently to set air quality standards, or whether developments in floodplains should prepare for the flood that is likely to occur once every fifty years, once every hundred years, or once every five hundred years (even assuming that calculation is stable, which is unlikely to be the case in the context of climate change). In an environment of constrained resources, we often must make hard decisions. We may decide to privilege, in certain circumstances, individual rights or social equity over the outcome that provides the greatest good for the greatest number—or vice versa. What is certain is that doing nothing simply because there is an absence of perfect information or political will has consequences and is seldom the optimal policy choice in managing an environment that is undergoing physical changes.

Regardless of what substantive decisions local governments may make, taking action to decrease sensitivity and increase the adaptive capacity of our communities will be key goals.³¹ Preparing for change will almost always be less expensive than repairing or replacing what is lost. Policy assessment tools, such as environmental impact assessment and scenario planning, among others, can help local governments to make sound choices even with imperfect information.³² Adaptive management techniques, which provide tools and principles for governments to

30. See Wendy E. Wagner, 95 COLUM. L. REV. 1613, 1619-22 (1995) for the seminal discussion of these concepts in the legal scholarly literature.

31. See Craig, *supra* note 3, at 31-40 (providing a thoughtful discussion of the importance of increasing adaptive capacity and methods for doing so).

32. See *id.* at 67-69. See *infra* section 3 and accompanying notes for a more detailed discussion of these tools.

ensure that they can learn and improve their management as conditions change and as they learn more about existing conditions, will further help to make sound policy choices under conditions of uncertainty.³³

III. USE EVALUATION TOOLS WITH PUBLIC PARTICIPATION COMPONENTS, SUCH AS ENVIRONMENTAL IMPACT ASSESSMENT AND SCENARIO PLANNING, TO PLAN FOR ADAPTATION TO FUTURE CONDITIONS

Planning and evaluation tools that incorporate meaningful public participation are especially well-suited to local government actions, since local governments have ample access to information about community needs and are sized to respond to these needs on a community scale. Thus, these tools can provide utility beyond what more top-down methods can provide.³⁴ Governments use impact assessment and other publicly-oriented evaluation and projection tools in a variety of contexts. Sometimes, government officials, private-sector critics, and scholars see these tools as inconsequential exercises, wastes of time, or impediments to meeting their goals.³⁵ But government can instead seize the opportunities that these tools provide, to engage in smarter analysis that will allow them to better understand the nature and magnitude of climate change impacts, to develop plans that reduce vulnerability and promote equitable outcomes, and to ensure that decisions take into account various possible future conditions and are optimized for the range of predicted futures.³⁶

Environmental Impact Assessment (EIA), as embodied in statutes such as the National Environmental Policy Act (NEPA) at the federal level and “little NEPAs” such as the California Environmental Quality Act (CEQA) at the state and local level, requires government agencies to consider the likely impacts of their actions before they act.³⁷ EIA provides a measure of public

33. See Craig, *supra* note 3, at 63-69, for more on adaptive management as a tool for addressing uncertain impacts of climate change.

34. See Michael B. Gerrard, *Climate Change and the Environmental Impact Review Process*, 23 NAT. RESOURCES & ENV'T 20, 23 (2008).

35. See Bradley C. Karkkainen, *Toward a Smarter NEPA: Monitoring and Managing Government's Environmental Performance*, 102 COLUM. L. REV. 903, 917-32 (2002) (discussing at length various basic critiques of environmental impact analysis generally and the National Environmental Policy Act (NEPA) in particular).

36. Katherine M. Baldwin, *NEPA and CEQA: Effective Legal Frameworks for Compelling Consideration of Adaptation to Climate Change*, 82 S. CAL. L. REV. 769, 800-08 (2009).

37. National Environmental Policy Act (NEPA), 42 U.S.C. § 4332(c) (1994) (NEPA); *Laurel Heights Improvement Ass'n v. Regents of Univ. of Cal.*, 764 P.2d 278, 282-83 (Cal. 1988) (“An EIR [under CEQA] is an ‘environmental ‘alarm bell’ whose purpose it is to alert the public and its responsible officials to environmental changes before they have reached ecological points of no return.’ The EIR is also intended ‘to demonstrate to an apprehensive citizenry

transparency and accountability by ensuring the public and other stakeholders' opportunities for pre-decision input.³⁸ Also, EIA can help achieve equitable distribution of burdens and benefits and help governments understand vulnerability through tools such as cumulative impact analysis. EIA tools—and little NEPA statutes, in particular, for those states that have such laws—can help local governments plan for climate change impacts.³⁹

CEQA provides a useful case study of the application of EIA to climate change adaptation. Under CEQA, local governments must study, disclose, analyze, and mitigate to the extent feasible any significant impacts of a proposed action on the environment.⁴⁰ Review typically includes analysis of the impact of new development on provision of emergency services, on availability of water to new residents, on exposure of people to seismic hazards, and on exposure of people to environmental contamination.⁴¹ By developing communities in a way that would expose them to these impacts, new development impacts the human environment in important ways. Similarly, if sea-level rise impacts future residents of a coastal project, EIA should develop information and

that the agency has, in fact, analyzed and considered the ecological implications of its action.' Because the EIR must be certified or rejected by public officials, it is a document of accountability. If CEQA is scrupulously followed, the public will know the basis on which its responsible officials either approve or reject environmentally significant action, and the public, being duly informed, can respond accordingly to action with which it disagrees. The EIR process protects not only the environment but also informed self-government.") (internal citations and quotations omitted).

38. See Kaswan, *supra* note 2 (discussing of the value of public participation in climate adaptation planning); Ernest Gellhorn, *Public Participation in Administrative Proceedings*, 81 YALE L.J. 359, 380-81, 403 (1972) (discussing the value of public participation through environmental impact assessment generally). *But see* Karkkainen, *supra* note 35, at 916-25 (critiquing this view of NEPA and similar statutes); *see also* Laurel Heights Improvement Ass'n, 764 P.2d at 281-85 (discussing rationale behind public participation requirement in CEQA).

39. See Baldwin, *supra* note 36, at 800-08 (discussing NEPA and CEQA as effective legal frameworks for addressing adaptation to climate change within federal agencies); *see also* Megan M. Herzog & Sean B. Hecht, *Combating Sea-Level Rise in Southern California: How Local Governments Can Seize Adaptation Opportunities While Minimizing Legal Risk*, 19 HASTINGS W.-NW. J. ENVTL. L. & POLY 463, 484-91 (2013) (discussing use of CEQA to address climate change's sea-level rise-related impacts).

40. CAL. PUB. RES. CODE §§ 21100(b), 21151 (Deering, LEXIS 1994); CAL. CODE REGS., tit. 14, §§ 15124, 15125, 15126.6, 15362 (Deering, LEXIS through 2014).

41. CEQA Guidelines Appendix G, available at http://ceres.ca.gov/ceqa/guidelines/Appendix_G.html (providing an "Environmental Checklist" for CEQA lead agencies to assess whether an EIR is necessary for a project, including questions relating to each of these environmental impacts); *Oakland Heritage Alliance v. City of Oakland*, 124 Cal. Rptr. 3d 755, 767-69 (Cal. Ct. App. 2010); *City of Long Beach v. L.A. Unified Sch. Dist.*, 98 Cal. Rptr. 3d 137, 152 (Cal. Ct. App. 2009).

mitigation measures sufficient to disclose and address the situation.⁴² Moreover, where a project will foreseeably affect the natural environment—for example, impeding the ability of wetlands or other coastal ecosystems to migrate inland as the sea encroaches—those impacts must be studied.⁴³

Local governments should choose to use EIA, where possible, to determine whether planned future development will reduce opportunities to preserve threatened ecosystems or put people in harm's way.⁴⁴ EIA provides an opportunity to compile, analyze, and provide mitigation opportunities for climate change-related impacts, including projected impacts of sea-level rise, in the context of new development.

Scenario planning is another useful tool for local governments as they plan for climate adaptation. Scenario planning involves describing and examining specific, distinct plausible futures that incorporate difficult challenges, and testing the ability of different strategies to meet the community's needs in response to those scenarios.⁴⁵ Scenario planning exercises are particularly helpful under conditions of significant uncertainty. These exercises require planning agencies to think creatively to consider a range of solutions, and thus to circumvent paralysis and conventional thinking that might make other planning methods ineffective or counterproductive.⁴⁶ Scenario analysis can illuminate place-specific strengths and vulnerabilities in planning for the future, without requiring analysis of every possible impact or variable.⁴⁷ So, for example, if scientists predict a range of possible sea-level rise scenarios ranging from fifty centimeters to one hundred centimeters over a period of time, scenario analysis could test the ability of a set number of selected strategies—developed with stakeholder input—to reduce the impacts of the rise in sea level under low, medium, and high sea-level rise scenarios.

Some parameters in the test scenarios may be linear and easy to apply (such as number of centimeters of sea-level rise). But

42. See Herzog & Hecht, *supra* note 39, at 487-90, and sources cited therein for a discussion of the rationale for analyzing sea-level rise-related impacts in EIRs. *But see* Ballona Wetlands Land Trust v. City of L.A., 134 Cal. Rptr. 3d 194 (Cal. Ct. App. 2011) (holding that sea-level rise and other impacts of “the environment on a project” do not require review under CEQA).

43. *Id.*; *see also* CAL. PUB. RES. CODE § 21068 (defining a “significant effect on the environment” as any “substantial, or potentially substantial, adverse change”).

44. Herzog & Hecht, *supra* note 39, at 487-90.

45. Craig, *supra* note 3, at 58-59; SARA S. MOORE, NATHANIEL E. SEAVY, & MATT GERHART, SCENARIO PLANNING FOR CLIMATE CHANGE ADAPTATION: A GUIDANCE FOR RESOURCE MANAGERS 5 (PRBO Conservation Science and the California Coastal Conservancy 2013).

46. *Id.*; *see also* ROBERT R.M. VERCHICK, FACING CATASTROPHE: ENVIRONMENTAL ACTION FOR A POST-KATRINA WORLD 239—49 (Harvard Univ. Press 2010).

47. MOORE ET AL., *supra* note 45, at 5-7.

other parameters may involve more complex assumptions about human behavior (such as how people will respond to incentives to weatherproof their property) or nonlinear natural processes (such as the dynamics of a storm). Properly implemented, scenario planning involves close input from stakeholders, including affected community members, technical experts, and policymakers, who develop the scenarios through a facilitated process. This process ensures buy-in from key players and fosters useful planning.

Tools such as harness existing, well-understood processes to evaluate adaptation strategies. Local governments should, where possible, utilize scenario planning, EIA, and similar public participation-oriented tools in order to better understand how climate change impacts might affect communities and how to address those impacts. Public participation in the adaptation planning process, through mechanisms such as using public knowledge to incorporate local knowledge of ecosystems, social dynamics, and economic concerns into adaptation plans, are similarly important for similar reasons. Finally, even outside of these formal analytical tools, local governments should recognize the value of incorporating public participation so that communities are well-informed about adaptation planning efforts and that they perceive their unique needs as being taken into account.

IV. UNDERSTAND AND USE LAND-USE PLANNING, EMERGENCY RESPONSE, AND OTHER AVAILABLE LOCAL GOVERNMENT TOOLS AND RESPONSIBILITIES

Local governments may underestimate the legal and policy tools they have available to address climate-change's impacts. Local governments possess a striking array of relevant powers. For example, thoughtful land-use planning decisions and building code provisions can ensure that construction is appropriate and resilient in areas that might be vulnerable to wildfire, flood, or storms.⁴⁸ Emergency response procedures can take into account current and future vulnerability and can prepare police and fire services and infrastructure maintenance adequately for climate change-related crises and trends.⁴⁹ And local governments can ensure that their own programs and assets account for climate change impacts, often through "no-regrets" strategies that can

48. Vicki Arroyo & Terri Cruce, *State and Local Adaptation*, in *THE LAW OF ADAPTATION TO CLIMATE CHANGE*, 569, 586-87 (Michael B. Gerrard & Katrina Fischer Kuh, eds. 2012); J. Peter Byrne & Jessica Grannis, *Coastal Retreat Measures*, in *THE LAW OF ADAPTATION TO CLIMATE CHANGE*, 267, 272-74; J. Cullen Howe, *Buildings*, in *THE LAW OF ADAPTATION TO CLIMATE CHANGE*, 209, 213-15, 221-24.

49. See, e.g., Victor B. Flatt, *Domestic Disaster Preparedness and Response*, in *THE LAW OF ADAPTATION TO CLIMATE CHANGE*, *supra* note 48, at 481, 492-94; Gremillion, *supra* note 7 (discussing strategies for building resilient cities).

have co-benefits to local communities, including, for example, ensuring that there are adequate disaster response procedures in place to respond to disaster crises, an adequate health care safety net and infrastructure to anticipate and respond to heat-related health issues, and other resources that will ensure community safety and health in a wide variety of crisis scenarios. Local governments that think through and deploy these multiple tools will be more likely to be successful in climate change planning.

Local governments exercise significant authority in several domains that relate to climate resilience and vulnerability. Relevant local government authorities include: buildings; energy efficiency; zoning and land use; waste collection and processing; proprietary authority over public property such as buildings, public utilities, and other public infrastructure; and emergency response and public health responsibilities.⁵⁰

Researchers and government agencies have proposed specific ways in which local governments might harness land-use powers, including zoning and building authority, to make reasoned choices to reduce vulnerability.⁵¹ These strategies may include, for example: implementing zoning overlays that drive changes in coastal development over time in response to varying needs in the face of changing coastal dynamics, requiring changes in construction that require construction with materials that reflect heat and reduce urban heat islands; or implementing building code provisions or standards for rebuilding after disasters that improve community resilience.⁵²

As another example, in their capacity as proprietors of parkland, including open space, beaches, and other recreational space and protected areas, local governments can make choices that decrease vulnerability to climate change. Understanding physical dynamics and maintaining these lands in ways that enable recreational activities and natural processes to flourish are

50. See Gremillion, *supra* note 7, at 1239-43. Cf. Katherine A. Trisolini, *All Hands on Deck: Local Governments and the Potential for Bidirectional Climate Change Regulation*, 62 STAN. L. REV. 669, 697 (2010) (noting the local government authority over many of these domains in the context of greenhouse gas emissions reduction).

51. See Gremillion, *supra* note 7, at 1239-43; see generally Herzog & Hecht, *supra* note 39, at 484-91 (discussing how the (California) Coastal Act and CEQA influence California state and local government policy on environmental impact planning); J. Peter Byrne, *The Cathedral Engulfed: Sea-Level Rise, Property Rights, and Time*, 73 LA. L. REV. 69, 85 (2012) (discussing the three types of California governmental responses to sea-level rise: "defense, retreat, or accommodation"); Jessica Grannis et al., *Coastal Management in the Face of Rising Seas: Legal Strategies for Connecticut*, 5 SEA GRANT L. & POL'Y J. 59, 61 (2012).

52. JESSICA GRANNIS, ADAPTATION TOOL KIT: SEA-LEVEL RISE AND COASTAL LAND USE 36, 38 (2011), available at http://www.georgetownclimate.org/sites/default/files/Adaptation_Tool_Kit_SL_R.pdf.

core responsibilities of a local government that maintains open space. In some cases, fulfilling these responsibilities may involve using available legal authorities to provide space to enable a wetland or dune system to migrate as erosion and other changes reshape coastlines. In other cases, it will require active management of open space to ensure protection of recreational resources, including measures such as sand replenishment or development of berms. As noted in the section below, local governments' parkland authorities and responsibilities may, in turn, be shaped or constrained by state or federal mandates such as the state coastal management programs, the public trust doctrine, or the federal Endangered Species Act. But typically, there is a robust role for local governments to play in managing their proprietary and trust resources in a way that incorporates climate change adaptation.

As a final example, local governments can tailor their public health and emergency response planning to ensure these essential services are resilient to climate-related shocks. Providing adequate emergency response services in a way that reflects preparedness for disasters, including public health emergencies, interruptions of basic services, and other likely scenarios will be an essential element of local governments' efforts to reduce vulnerability and build resilience.

Local governments possess tools to help them ensure that they are aware of their authorities and use them effectively. Local governments should ensure that staffs are tasked with acquiring and maintaining knowledge of available resources in a systematic, ongoing way. Efforts to participate in regional climate adaptation planning consortiums, in collaboration with other local governments, academic institutions, and state and federal partners can assist local governments with this important work.

V. UNDERSTAND THE STATE AND FEDERAL LEGAL AND POLICY CONTEXT

Federal and state legal doctrines, regulations, and programmatic initiatives often interact with local initiatives. Policy and doctrine at other levels of government may present both opportunities and barriers for sound local adaptation strategies. Consequently, it is crucial that local governments understand the ways that state and federal programs and laws might serve to work together with, or against, various potential local adaptation strategies.

In the context of sea-level rise and flooding, the National Flood Insurance Program (NFIP) and the California Coastal Act provide examples of federal and state legal regimes that can either provide support for robust sea-level rise planning or serve as a hindrance to that planning, depending on various factors. The

NFIP insures millions of homes against flood damage, in the absence of a robust private insurance market.⁵³ The NFIP has also helped to reduce vulnerability to flood hazards on new properties, by requiring that local building codes and permits render new construction in hazard-prone areas safe from high risk of flooding.⁵⁴ The NFIP also has a voluntary component, the Community Rating System (CRS), which is particularly relevant to local adaptation planning: communities that adopt and maintain floodplain management regulations can receive reduced premiums for federal flood insurance, as well as disaster assistance and mitigation grants. The CRS awards flood-insurance premium reductions to homeowners in participating communities, based on community action to reduce vulnerability through floodplain management.⁵⁵ The program thus can provide “win-win” outcomes, in which homeowners benefit individually from premium reductions—building their capacity to cope by reducing their costs, while the community as a whole benefits from the floodplain management activities that achieve the CRS rating—reducing vulnerability overall. Local governments that have opted into the CRS can also condition rebuilding in specific ways that promote adaptation.⁵⁶ Understanding how to participate effectively in this program, through implementation of appropriate resilience-building measures, is crucial for local governments in flood-risk areas if they wish to build community support for vulnerability-reduction.

The NFIP’s efficacy depends in large part on FEMA’s mapping of floodplain areas, which directs NFIP resources and requirements to areas that are at high risk of flooding. Unfortunately, until recently, FEMA’s mapping of floodplain areas did not take projected sea-level rise into account, which made its utility for sea-level rise adaptation quite low;⁵⁷ but under recent legislation, FEMA will be able to take into account projected sea-level rise and other emerging science affecting coastal dynamics in its future mapping.⁵⁸ And accordingly, local governments will also be able to use this information to plan their own strategies.

But the NFIP can also work against resilience-building, by offering subsidized premiums that encourage homeowners to build and rebuild on properties that are especially vulnerable to floods.⁵⁹

53. See Byrne & Grannis, *supra* note 48, at 291-92; Sean B. Hecht, *Insurance*, in *THE LAW OF ADAPTATION TO CLIMATE CHANGE*, *supra* note 48, at 511, 527-28.

54. See Hecht, *supra* note 53, at 528.

55. See Byrne & Grannis, *supra* note 48, at 292.

56. See Byrne, *supra* note 51, at 85.

57. See *id.* at 291.

58. The Biggert-Waters Flood Insurance Reform Act of 2012 (“Reform Act”), H.R. 4348, 112th Cong. § 100215(d) (2012); *id.* § 100216; see also Byrne & Grannis, *supra* note 48, at 291; Hecht, *supra* note 53, at 528.

59. Byrne & Grannis, *supra* note 48, at 291-92; Hecht, *supra* note 53, at

While recent amendments to the National Flood Insurance Act are likely to reduce this problem,⁶⁰ individual homeowners can sometimes take advantage of unintended impacts of the NFIP to the detriment of sound community planning. In particular, rebuilding may interfere with local government strategies that involve accommodation or retreat in order to gradually adapt to the changing contours of a coastline or floodplain.⁶¹ California agencies have encouraged local governments to consider implementing rebuilding restrictions to avoid this problem.⁶²

State laws and policies can also provide important context for local initiatives. Almost all states have adopted coastal management programs under the Coastal Zone Management Act (CZMA).⁶³ In California, for example, the California Coastal Act (Coastal Act) governs most coastal development. Local governments can use their Local Coastal Programs (LCPs) certified under the Coastal Act as vehicles for zoning and planning for adaptation to sea-level rise.⁶⁴ The Coastal Act governs planning and development permitting in the coastal zone (approximately 1000 feet inland from the shoreline).⁶⁵ Within the coastal zone, the Coastal Act protects environmental quality, ensures a balance of use and conservation of coastal zone resources, maximizes public access subject to property rights and resource conservation principles, provides for priority for coastal-dependent uses, and encourages cooperation between state and local planning initiatives.⁶⁶ Local governments can utilize coastal land-use

528-29; Robert R.M. Verchick & Joel D. Scheraga, *Protecting the Coast*, in THE LAW OF ADAPTATION TO CLIMATE CHANGE, *supra* note 48, at 235, 250; Byrne, *supra* note 51, at 85.

60. Byrne & Grannis, *supra* note 48, at 292 (discussing specific provisions of the Reform Act); Hecht, *supra* note 53, at 529 (same); Robert R. M. Verchick and Lynsey R. Johnson, *When Retreat is the Best Option: Flood Insurance after Biggert-Waters and Other Climate Change Puzzles*, 47 J. MARSHALL L. R. (2014) Forthcoming) (discussing the Homeowners Flood Insurance Affordability Act (HFIAA), Pub. L. No. 113-89, § 1(a) (2014), which further amended the National Flood Insurance Act by rolling back some of the reforms enacted just two years ago through the Reform Act).

61. Byrne, *supra* note 51, at 85.

62. *2009 California Climate Adaptation Strategy: A Report to the Governor of the State of California in Response to Executive Order S-13-2008*, CAL. NATURAL RESOURCES AGENCY 77 (2009) http://resources.ca.gov/climate_adaptation/docs/Statewide_Adaptation_Strategy.pdf (last visited May 20, 2014).

63. Coastal Zone Management Act of 2005, 16 U.S.C. § 1451 (2006).

64. Accord Nicole Russell & Gary Griggs, *Adapting to Sea Level Rise: A Guide for California's Coastal Communities*, CAL. ENERGY COMM'N, 1, 32 (2012), *available at* <http://seymourcenter.ucsc.edu/OOB/Adapting%20to%20Sea%20Level%20Rise.pdf>.

65. CAL. PUB. RES. CODE § 30103.

66. *Id.* § 30001.5.

planning to facilitate adaptation to sea-level rise by, for example, “identifying areas where natural shoreline preservation or hard armoring is critical, increasing development resilience, restricting further coastal armoring, channeling future development away from sea-level rise exposure zones, and contemplating the siting of new or relocated municipal infrastructure.”⁶⁷

The Coastal Act also, however, includes provisions that limit local responses to sea-level rise. For example, section 30235 of the California Public Resources Code provides that under certain circumstances, property owners retain the right to armor their shoreline property through the use of hard structures that may be maladaptive in the context of sea-level rise.⁶⁸ Hard armoring tends to adversely affect beaches and neighboring properties, and widespread hard armoring is likely to interfere with overall efforts to adapt coastal lands to changing coastal contours.⁶⁹

The Coastal Act thus provides a useful example of why it is crucial for local governments to understand how various state-law doctrines interact with sea-level rise. For impacts other than sea-level rise and related flood risks, local governments should similarly consider the ways in which state and federal programs and doctrines can help or hinder adaptation efforts. Other federal and state legal doctrines that govern property ownership and use, including but not limited to the public trust doctrine;⁷⁰ constitutional limitations on the taking of property without just compensation;⁷¹ and nuisance law⁷² may affect local governments’ efforts to plan for sea-level rise, wildfire risk, and other consequences of climate change.

Local governments should similarly be aware of the legal regimes—typically based on state laws and regulations—that govern water and energy supply and demand in their communities, since in times of water or energy shortage or other crisis local governments will be on the hook to address community needs.⁷³ Moreover, local land use, building codes, stormwater

67. Herzog & Hecht, *supra* note 39, at 485; see also Meg Caldwell & Craig Holt Segall, *No Day at the Beach: Sea Level Rise, Ecosystem Loss, and Public Access Along the California Coast*, 34 *ECOLOGY L.Q.* 533, 549 (2007).

68. CAL. PUB. RES. CODE § 30235.

69. See generally Herzog & Hecht, *supra* note 39.

70. See generally Tim Eichenberg, Sean Bothwell, & Darcy Vaughn, *Climate Change and the Public Trust Doctrine: Using an Ancient Doctrine to Adapt to Rising Sea Levels in San Francisco Bay*, 3 *GOLDEN GATE U. L. REV.* 234 (2010).

71. See Byrne, *supra* note 51.

72. Lara D. Guercio, *Climate Change Adaptation and Coastal Property Rights: A Massachusetts Case Study*, 40 *B.C. ENVTL. AFF. L. REV.* 349, 382-84 (2013).

73. See generally Robert W. Adler, *Managing Water Supplies*, in *THE LAW OF ADAPTATION TO CLIMATE CHANGE*, *supra* note 48, at 51; Benjamin Houston & Noah D. Hall, *Managing Demand for Water*, in *THE LAW OF ADAPTATION TO CLIMATE CHANGE*, *supra* note 48, at 95; Robin Kundis Craig, *Energy System*

management, and other local authority can deeply impact both supply and demand for water and energy, creating opportunities to build resilience and reduce vulnerability.⁷⁴ Planning for supply and demand management during difficult times should thus be part of local governments' basic preparation.

States and the federal government maintain or share responsibility over many aspects of climate change preparedness that affect local government responses. For example, because climate-related risks include failure of infrastructure such as roads, sewage treatment, and other government functions, climate adaptation must include an understanding of the state and federal legal tools that govern this infrastructure.⁷⁵ State building codes interact with local regulation to affect energy conservation, resilience to disaster, and other factors relating to climate risk. Local governments also should be aware of federal disaster relief under the Stafford Act and state disaster relief under various state laws.⁷⁶ More generally, local governments should understand State adaptation policies and tools within their jurisdictions. Many states have provided resources to assist local government planning and mandates that affect local governments' responsibilities.⁷⁷ And finally, as discussed further under recommendation number seven below, local governments should be aware of federal and state laws that address or exacerbate social and economic inequity.

While local governments must consider a broad range of laws and policies, these laws and policies provide opportunities to address climate change risks effectively and efficiently.

VI. CONSIDER HOW OTHER LOCAL GOVERNMENT INITIATIVES WILL HELP OR HINDER ADAPTATION TO CLIMATE CHANGE IMPACTS

Climate change adaptation will not happen in a vacuum. Other local government programs and actions may have either synergistic or negative interactions with climate adaptation. For example, many local governments are already working on reducing greenhouse gas emissions through lowering energy consumption, improving transportation networks, and changing the sources of local energy.⁷⁸ These measures will, in some cases, increase resiliency or reduce vulnerability. For example, policies that encourage or require "cool roofs" – roofs made of materials that

Impacts, in THE LAW OF ADAPTATION TO CLIMATE CHANGE, *supra* note 48, at 133.

74. Adler, *supra* note 73, at 69-71; Houston & Hall, *supra* note 73, at 99-104.

75. See generally Gregory E. Wannier, *Infrastructure*, in THE LAW OF ADAPTATION TO CLIMATE CHANGE, *supra* note 48, at 173.

76. See generally Flatt, *supra* note 49.

77. Arroyo & Cruce, *supra* note 48.

78. See Trisolini, *supra* note 50, at 697.

reflect sunlight – can reduce energy use, and at the same time both reduce urban temperature and decrease the likelihood of crises at peak electrical demand times.⁷⁹ Conversely, some mitigation measures may increase vulnerability, reduce resiliency, or exacerbate inequitable impacts. For example, increasing density around transportation corridors – an increasingly popular strategy for reducing vehicle miles traveled and encouraging walking and the use of public transit – can in some cases, put more people near sources of particulate matter, with impacts on public health that may themselves become more severe as heat becomes more severe.⁸⁰ When local governments make decisions, they should think and plan holistically, taking into account both positive synergies and negative interactions.

Communities can also plan for adaptation by understanding the climate change adaptation value of existing or planned initiatives that advance other goals. These “win-win” measures will reinforce existing community resilience-building and vulnerability-reducing initiatives. For example, policies that focus on reduced fossil fuel consumption and on water conservation can reduce our reliance on fossil fuels and thus reduce greenhouse gas emissions, and also will make our communities more resilient to shocks and more capable of addressing future climatic change.⁸¹ Many communities are successfully implementing energy conservation measures and distributed renewable generation. Both of these will reduce reliance on the electrical grid and will make communities more self-sustaining in the event of a disastrous event.⁸² Similarly, widespread implementation of cool roof technology through municipal policies shows the promise of reducing the heat island effect and thus lowering urban temperatures, while reducing energy consumption.⁸³ Finally, the types of actions mentioned below in recommendation number seven, which are aimed at reducing vulnerable populations’ burdens, all involve increases to public welfare that also facilitate resilience-building in the face of climate-related impacts.

On the other hand, some other local government initiatives may involve significant trade-offs between climate adaptation and other values. For example, many local governments, concerned

79. See Cara Horowitz, *Bright Roofs, Big City: Keeping L.A. Cool Through An Aggressive Cool-Roof Program*, EMMETT CENTER ON CLIMATE CHANGE AND THE ENVIRONMENT, available at http://cdn.law.ucla.edu/SiteCollectionDocuments/Centers%20and%20Programs/Emmett%20Center%20on%20Climate%20Change%20and%20the%20Environment/Pritzker_02_Bright_Roofs_Big_City.pdf (discussing in detail the benefits of cool roof technology in Los Angeles, with applicability for other urban areas).

80. Kaswan, *supra* note 2.

81. Gremillion, *supra* note 7, at 1240-41.

82. *Id.*

83. Horowitz, *supra* note 79.

about social and environmental problems associated with strong reliance on automobiles, are enacting policies aimed at increasing urban density, reducing vehicle miles traveled, and creating more walkable communities near transit.⁸⁴ These policies—implemented through, for example, zoning policies that encourage dense “smart growth” development—may in some cases have the negative impact of increasing exposure to particulate matter and other pollutants, or increasing heat impacts nearby.⁸⁵ Because these policies might negatively affect socioeconomically disadvantaged communities which are most vulnerable to impacts, they are particularly important to consider.⁸⁶ Moreover, as researcher Lisa Grow Sun has noted, such initiatives may in some cases encourage “smart growth in dumb places” that actually reduces resilience to disaster and harms communities in the long run, by encouraging density in areas that may be particularly vulnerable to floods, wildfires, or other risks.⁸⁷

Local communities that are mindful of both the positive synergies and the negative tradeoffs that policies may bring for climate adaptation will reduce vulnerability, build resilience, and promote social equity most effectively. Communities should choose to consider, and mitigate, the potential maladaptive consequences of policies that do not on their face implicate climate adaptation, such as “smart growth” policies, and should take advantage of the vulnerability-reducing and resilience-building synergies associated with policies that reduce resource consumption, promote public health, and build capacity for local self-reliance for resources such as energy and water.

VII. TAKE ACTIONS TO REDUCE POPULATIONS’ VULNERABILITY TO STRESSORS, WITH A SPECIAL FOCUS ON THOSE WHO ARE ALREADY AMONG THE MOST VULNERABLE

Local governments already face the challenge of meeting responsibilities to manage people, infrastructure, and resources. In many cases, local governments manage important aspects of the social safety net (particularly health care), public works, transportation, and emergency response functions for residents. Climate change impacts will exacerbate existing scarcity, conflict, and inequities relating to these functions. As a result, it is important that local governments ensure that these programs are robust and resilient to shocks. This includes ensuring that the most vulnerable (low-income individuals and families, the elderly,

84. Trisolini, *supra* note 50.

85. Kaswan, *supra* note 2, at 11143.

86. See discussion *infra*, Section 7, and accompanying notes.

87. See generally Lisa Grow Sun, *Smart Growth in Dumb Places: Sustainability, Disaster, and the Future of the American City*, 2011 BYU L. REV. 2157 (2011).

and others with special challenges and limited access to resources) have access to resources such as health care, transportation, and social services.

The difficulties associated with breakdown of infrastructure and services will disproportionately affect certain communities. As noted above and documented by Alice Kaswan,⁸⁸ Rob Verchick,⁸⁹ and Susan Cutter,⁹⁰ among others, vulnerability to climate change impacts is correlated with social vulnerability, and the most vulnerable tend to be poor, elderly, members of racial minority groups, recent immigrants, and members of communities dependent upon resources that themselves are physically vulnerable. In a major disaster, individuals occupying poorly-constructed homes in communities without deep financial resources, adequate health care facilities, or sophisticated infrastructure are likely to be devastated, while those in comparatively wealthier circumstances are likely to be resilient. Communities that are on the edge of coping may break down in ways that make their populations even more vulnerable. Even in less catastrophic circumstances, such as moderate heat waves or relatively mild disease outbreaks, the most vulnerable populations may be hard-hit. Thus, as Kaswan has argued, adaptation to climate impacts should address vulnerability and build resilience before difficulty arises, rather than rely primarily on efforts to repair or rebuild after a calamity.⁹¹

Local governments are uniquely situated to manage social disruptions caused by stresses to the physical environment. Local governments "are on the front line responding to public health emergencies."⁹² Local police and fire departments are responsible for keeping order and responding to diverse types of emergencies that affect communities and individuals.⁹³ Local agencies typically manage sewage, stormwater, and other basic functions that can be disrupted in emergencies. Advance planning to ensure that these functions are resilient to climate change-related disruptions is thus a crucial element of planning for climate change impacts. Moreover, the impact of disaster-related disruptions of basic social services and infrastructure will fall disproportionately on the most

88. Kaswan, *supra* note 2.

89. Verchick, *supra* note 19, at 38-45.

90. SUSAN L. CUTTER ET AL., SOCIAL VULNERABILITY TO CLIMATE VARIABILITY HAZARDS: A REVIEW OF THE LITERATURE (2009) (reviewing a wide range of science- and social-science-based research on the social dimensions of vulnerability to climate change impacts)

91. Kaswan, *supra* note 2, at 11138.

92. Sarah Lister, *An Overview of the U.S. Public Health System in the Context of Emergency Preparedness* 12 (CONG. RES. SERV., March 17, 2005), available at <https://www.fas.org/sgp/crs/homesecc/RL31719.pdf>.

93. Jeanne-Marie Col, *Managing Disasters: The Role of Local Government*, 2007 PUB. ADMIN. REV. 114, 115 (2007), available at <http://unpan1.un.org/intradoc/groups/public/documents/UNDP/UNPAN032134.pdf>.

vulnerable, requiring special attention in advance by local governments to ensure that resources are deployed to protect these residents and communities. At least as significantly, actions that proactively improve the overall welfare of residents—particularly the most vulnerable—will prove especially helpful in climate change adaptation. Thus, providing adequate health care and sanitation resources, emergency services, and basic public services in a way that promotes equity among communities will be crucial.

Properly implemented, the adaptation planning process will take into account the special vulnerability of communities and individuals with fewer resources, and it will assess vulnerability and needs and develop strategies that specifically ensure that those communities and individuals will not be left behind. Moreover, utilizing public participation strategies and tools that synthesize broad input from community members— as suggested in Part III, *supra*—will support the objective of reducing social vulnerability.

VIII. CONCLUSION

While it is clear that local governments will play an essential role in adapting to climate change impacts, the tasks facing government agencies are daunting, and most local governments have scarcely begun to engage in the planning necessary to accomplish these goals. The principles articulated here are intended to help communities beginning their adaptation planning processes to ensure that they are focusing on key issues, and not treating adaptation planning as a narrow, formal exercise or as a set of benchmarks to be achieved. With proper attention to both the big picture and the details, local governments can use climate change adaptation as an opportunity to acknowledge and confront the dynamic challenges of ensuring health, safety, and security in an ever-changing world.

