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LOCAL SOLUTIONS TO THE GLOBAL CRISIS: A GUIDE TO CLIMATE-RESILIENT DEVELOPMENT

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SUMMARY

In February 2022, the Intergovernmental Panel on Climate Change (IPCC) promulgated climate-resilient development (CRD), which combines adaptation and mitigation as a principal strategy for managing climate change. This Article discusses local land use law in the context of CRD and provides a methodology for identifying and evaluating strategies that address the global climate crisis at the local level. Local governments have the power to integrate land use strategies that include CRD components, and the IPCC identified these strategies as effective tools for implementing CRD. This Article provides a framework that defines the evolving field of CRD and facilitates its implementation.

In February 2022, the Intergovernmental Panel on Climate Change (IPCC) promulgated climate-resilient development (CRD) as a principal strategy for managing climate change: "There is a rapidly narrowing window of opportunity to enable climate resilient development. Multiple climate resilient development pathways are still possible by which communities, the private sector, governments, nations, and the world can pursue climate resilient development."[1] CRD combines adaptation and mitigation strategies to achieve sustainable development for all. Additionally, CRD is furthered through resilience and enabling conditions that increase the feasibility and long-term success of implementation strategies.

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1. IPCC, *Summary for Policymakers*, *in* Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change 30 (Cambridge Univ. Press 2022), https://report.ipcc.ch/ar6wg2/pdf/IPCC_AR6_WGII_SummaryForPolicymakers.pdf.

The IPCC identified local land use strategies as effective tools for implementing CRD.[2] The effects of climate change are intrinsically local. As climate change has worsened, many local governments have adopted land use policies and regulations to manage climate change, and others are searching for effective provisions. This Article discusses local land use law in the context of CRD. It provides a legal framework and evaluation methodology to assist local officials in updating existing laws and adopting wholly new laws that embody and further the components of CRD.

Part I of the Article introduces the key terms of CRD as defined by the IPCC. Part II discusses the authority of the IPCC and the role of local governments in advancing CRD. Part III strengthens the connection between land use law and local government to achieve the overarching objectives of CRD. Part IV sets forth a step-by-step methodology and educational tool to assist local officials and their advisors, as well as community leaders, in identifying, evaluating, and improving upon existing climate management strategies to better achieve CRD. Part V provides several case studies of local government strategies that closely align with the objectives of CRD, and identifies opportunities for improvement. Part VI emphasizes the efforts

2. *See id.* at 8-39 ("Whether and to what extent such emission reduction potentials can be realized depends on how cities are designed and laid out.").

required on behalf of local governments to address climate change, and closes with three essential takeaway lessons that the complexities of climate change and CRD teach.

I. CRD Defined: Key Terms[3]

The IPCC defines *climate-resilient development* as "an approach that integrates adaptation measures and their enabling conditions with mitigation to advance sustainable development for all." *Adaptation* is defined as the process of adjusting to actual or expected climate and its effects, to moderate harm or take advantage of beneficial opportunities. Adaptation can be anticipatory or reactive. *Mitigation* is defined as an anthropogenic intervention to reduce the sources or enhance the sinks of greenhouse gases (GHGs).[4]

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.[5] Achieving sustainable development for all requires that CRD provisions be equitable. *Equity* is concerned with fairness in the way people are treated, based on societal values. The local and regional Government Alliance on Race and Equity (GARE) explains that equity looks to communities' conditions to eliminate racial inequity and provide opportunities so that all groups may succeed.[6]

Maladaptation is defined by the IPCC as an intervention in one location or sector that could increase the vulnerability of another location or sector, or increase the vulnerability of the target group to future climate change.[7] A response to climate change is maladaptive when it creates lock-ins of vulnerability, exposure, and risks that are difficult and expensive to change and that exacerbate existing inequalities. Maladaptation can be avoided by flexible, multi-sectoral, inclusive, and long-term planning and implementation of adaptation actions with benefits to many sectors and systems.

Resilience is defined by the IPCC as the capacity of social, economic, and ecological systems to cope with a hazardous event, trend, or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure. There are three main pillars of resilience. *Social resilience* refers to a community's ability to recover from disturbances and losses, such as natural disasters, with little aid from other sources.[8] *Economic resilience* refers to the ability to recover from, withstand, and prevent disruptions to the economic base of an area.[9] *Ecological resilience* refers to the status of an ecosystem's health and its ability to bounce back after disturbances.[10] Ecological health can be measured by certain metrics, such as species richness and species abundance.[11]

The successful implementation of CRD strategies depends on whether the necessary enabling conditions are present. *Enabling conditions* are conditions that are key for implementing, accelerating, and sustaining adaptation in human systems and ecosystems. These include political commitment and follow-through, institutional frameworks, policies and instruments with clear goals and priorities, enhanced knowledge on impacts and solutions, mobilization of and access to adequate financial resources, monitoring and evaluation, and inclusive governance processes. Enabling conditions often determine whether a particular adaptation option may be implemented. *Feasibility* considers the potential for an adaptive measure to be implemented and maintained successfully.

II. Creating a Framework for CRD

A. Role of the IPCC

The IPCC produces comprehensive climate reports.[12] Formed in 1988, it consists of 195 national governments and is assisted by hundreds of scientists and other experts.[13] These advisors review thousands of climate science research reports contributed by the global scientific community. In 1990, the IPCC's First Assessment Report addressed the importance of climate change and called for international cooperation and negotiation to achieve climate change solutions.[14]

The IPCC created three working groups (WGs), each tasked with certain topics and objectives.[15] WG I focuses on the physical basis of climate science.[16] WG II addresses the need for adaptation policies.[17] WG III develops mitigation

3. All following terms in italics, unless otherwise noted, are direct quotes from IPCC, *supra* note 1.
4. Richard J.T. Klein et al., *Inter-Relationships Between Adaptation and Mitigation*, *in* Climate Change 2007: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (M.L. Parry et al. eds., Cambridge Univ. Press 2007), https://www.ipcc.ch/site/assets/uploads/2018/02/ar4-wg2-chapter18-1.pdf.
5. United Nations, *Sustainability*, https://www.un.org/en/academic-impact/sustainability (last visited Sept. 8, 2022).
6. GARE, GARE Communications Guide 35 (2018), https://www.racialequityalliance.org/wp-content/uploads/2018/05/1-052018-GARE-Comms-Guide-v1-1.pdf.
7. Ian R. Noble et al., *Adaptation Needs and Options*, *in* Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change 833, 837 (C.B. Field et al. eds., Cambridge Univ. Press 2014), https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap14_FINAL.pdf.
8. Rosanne Anholt et al., *Understanding Societal Resilience: The Case for Engaged Scholarship*, *in* Multisystemic Resilience: Adaptation and Transformation in Contexts of Change 551, 711 (Michael Ungar ed., Oxford Univ. Press 2021), https://oxford.universitypressscholarship.com/view/10.1093/oso/9780190095888.001.0001/oso-9780190095888-chapter-29.
9. U.S. Economic Development Administration, *Economic Resilience*, https://www.eda.gov/ceds/content/economic-resilience.htm (last visited Sept. 8, 2022).
10. Simon Levin, *Ecological Resilience*, Encyclopedia Britannica, https://www.britannica.com/science/ecological-resilience (last visited Sept. 8, 2022).
11. *Id.*
12. IPCC, *About the IPCC*, https://www.ipcc.ch/about/ (last visited Sept. 8, 2022).
13. IPCC, *Overview*, *in* First Assessment Report 51 (1990), https://www.ipcc.ch/site/assets/uploads/2018/05/ipcc_90_92_assessments_far_overview.pdf.
14. *Id.*
15. *Id.*
16. *Id.*
17. *Id.*

strategies to combat climate change.[18] Initially, adaptation and mitigation were considered to be separate approaches to manage climate change.

Over time, the WG strategies were integrated following the emergence of new climate change data and more sophisticated implementation mechanisms. The Fifth Assessment Report, released in 2014, merged adaptation and mitigation.[19] In the 2022 Sixth Assessment Report, WG II adopted CRD as a principal strategy, noting that it "integrates adaptation measures and their enabling conditions with mitigation to advance sustainable development for all."[20]

The IPCC's research and solutions at the global, national, and local levels have garnered significant respect. The IPCC has proven to be influential in city planning nationwide. For example, Denver's Office of Climate Action, Sustainability, and Resiliency relies on the climate science from the IPCC reports to plan and set goals.[21] San Francisco also relies on the IPCC's reports to develop its Climate Action Plan to address the threats posed by climate change while emphasizing the need for equitable solutions.[22]

B. Local Land Use Strategies That Advance CRD

Local governments can adopt, enforce, and incentivize CRD strategies to control and shape land use through regulation, capital spending, and policy. CRD components can be found in comprehensive land use planning. CRD is implemented by strategies that ensure low-carbon building, reduce car dependency through decarbonized transportation, and foster green infrastructure and carbon sequestration. Additionally, cities achieve low-carbon development and affordable housing through infill and adaptive reuse, taking pressure off greenfields for future development.

Climate-related disasters can be anticipated and managed by hazard mitigation planning and development. Strategies that incorporate resilient adaptation to sea-level rise and inland flooding can minimize the impacts of climate hazards. To achieve sustainable development for all, local governments must incorporate equity and justice in their CRD strategies. Climate management strategies must also be informed by science and formulated through multidisciplinary collaboration to ensure resilience, avoid maladaptation, and be feasible.

III. Land Use Law in the Context of CRD

CRD is a new frontier in the response to climate change that calls for action at all levels: from international to national and from regional to local. The IPCC's Sixth Assessment Report released by WG II highlights that CRD is more effective when "it is responsive to regional and local land use development and adaptation gaps, and addresses the underlying drivers of vulnerability."[23] Through strategic public investment, regulations, and incentives, land use can incorporate climate change management at the local level that can culminate in a meaningful global response.[24]

As a means to implement CRD, IPCC's WG II specifically discusses the role of land use controls: "Planning for CRD can support both adaptation and decarbonisation via effective land use, promoting resilient and low-carbon infrastructure; protecting biodiversity and integrating ecosystem services, assuming advancing just and equitable development processes."[25] This emphasis on land use development also is found in WG III's Sixth Assessment Report:

> The potential and sequencing of mitigation strategies to reduce GHG emissions will vary depending on a city's land use, spatial form, development level, and state of urbanization. Strategies for established cities to achieve large GHG emissions savings include efficiently improving, repurposing, or retrofitting the building stock, targeted infilling, and supporting non-motorized (e.g., walking, bicycling) and public transport. Rapidly growing cities can avoid future emissions by co-locating jobs and housing to achieve compact urban form, and by leapfrogging or transitioning to low-emissions technologies.[26]

WG III also refers to enhancing carbon uptake and storage in the urban environment, for example through bio-based building materials, permeable surfaces, green roofs, trees, green spaces, rivers, ponds, and lakes.[27] A July 2022 Planning Advisory Service Report of the American Planning Association notes:

> There is widespread recognition that patterns of development have significant implications regarding global emissions and resulting consequences. In particular, rethinking

18. *Id.*
19. IPCC, *Summary for Policymakers*, *in* Climate Change 2014 Synthesis Report (Cambridge Univ. Press 2014), https://www.ipcc.ch/site/assets/uploads/2018/02/AR5_SYR_FINAL_SPM.pdf.
20. IPCC, *supra* note 1, at 30.
21. Denver Office of Climate Action, Sustainability, and Resilience, Climate Protection Fund Five-Year Plan 9-13 (2022), https://denvergov.org/files/assets/public/climate-action/cpf_fiveyearplan_final.pdf.
22. San Francisco Department of the Environment, San Francisco's Climate Action Plan 2021, at 13 (2021), https://sfenvironment.org/sites/default/files/cap_fulldocument_wappendix_web_220124.pdf.
23. IPCC, *supra* note 1, at 34.
24. David Dodman et al., *Cities, Settlements and Key Infrastructure*, *in* Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change 907, 947 (H.-O. Pörtner et al. eds., Cambridge Univ. Press 2022), https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_Chapter06.pdf.
25. E. Lisa F. Schipper et al., *Climate Resilient Development Pathways*, *in* Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change 2655, 2658 (H.-O. Pörtner et al. eds., Cambridge Univ. Press 2022), https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_Chapter18.pdf.
26. IPCC, Climate Change 2022: Mitigation of Climate Change. Working Group III Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change SPM-39, https://report.ipcc.ch/ar6wg3/pdf/IPCC_AR6_WGIII_FinalDraft_FullReport.pdf.
27. *Id.*

> the spatial configuration and systems that enable cities to function . . . may prove to be some of the most effective and impactful opportunities to rapidly reduce GHG emissions and mitigate climate change. . . . [I]mplementation for climate mitigation and adaptation action will require fundamental shifts in governance, community growth and redevelopment, and essential services. . . .[28]

IV. Evaluation Methodology

A. *Step-by-Step Methodology*

Given the recent emergence of CRD, there are few existing climate management strategies that embody all of its components, and the IPCC provides little guidance to individual communities on how to proceed if they are just beginning their climate management strategies. Communities need to know about these CRD components and how to draft feasible provisions.

The following methodology focuses on evaluating existing climate management land use laws. It is designed to assist local officials and their advisors, including community leaders, in amending those laws to integrate adaptation and mitigation, and achieve resilience, avoid maladaptation, and accomplish equity. The result should be the adoption of competent CRD laws that serve as models for action in peer communities. In each step of the methodology, questions are asked to guide evaluators in the process of identifying how to strengthen existing laws to better achieve CRD.

Step 1: Strategy Objectives

Key Question 1: **What are the stated objectives of the strategy?**

The overt objectives of a local law typically are found in its Findings or Purpose section. Many of the earlier climate change management laws were designed to mitigate climate change by reducing carbon emissions by promoting, for example, low-carbon land uses. More recent laws might seek to both mitigate and adapt to climate change on their face, indicating an effort to integrate these CRD objectives. The absence of any objective should be noted by the evaluator and corrective language added.

Key Question 2: **What are the implied objectives of the strategy?**

Beyond the Findings provisions, implied objectives may be found in the local law's descriptions of the problems to be solved and contain provisions that address them. A provision that aims to prevent damage from sea-level rise or storm surges, such as creating a living shoreline, is, on its face, an adaptation strategy. This will likely be the stated objective found in the Findings or Purpose language of the law.

The implementation details in that law may demonstrate, however, that it will increase the vegetative environment and thus sequester carbon so that by implication it is a mitigation strategy. Urban tree canopy plans are often adopted to mitigate climate change through biological sequestration but may achieve an implied adaptive purpose by reducing the urban heat island effect. The evaluator should add language to the law that makes the implicit objective overt.

Step 2: CRD Objectives to Be Achieved

Key Question: **What CRD objectives does the strategy achieve?**

How does the evaluator determine whether the existing climate change management law contains methods that achieve the three essential objectives of CRD: adaptation, mitigation, and equity? The evaluator must look for one or more strategies aimed at each of these critical objectives, strengthen them where they may be weak, and include them where they may be absent.

a. Adaptation: **Does the strategy adjust to present and future climate effects?**

Adaptation measures may be approached in one of two ways: they may either react to existing climate conditions or anticipate future effects. *Reactive adaptation* addresses climate impacts that have already been observed and seeks to absorb and adjust to potential harms. *Anticipatory adaptation* acts in advance of impacts in order to manage future risks.[29] For example, increasing the amount of pervious surface area in a neighborhood that experiences inland flooding is a reactive adaptation, while updating zoning codes to minimize impervious development in areas susceptible to future sea-level rise is anticipatory adaptation.

To achieve adaptation, strategies must fall into one or more of the following categories: protection, accommodation, retreat, and avoidance.[30] *Protection strategies* contain structurally defensive measures that shield vulnerable environments, infrastructure, or communities from harm.[31] Seawalls or living shorelines are examples of strategies that protect against sea-level rise and storm surges. *Accommodation strategies* involve altering existing infrastructure so that it is capable of resisting changing conditions.[32] This may include building retrofits with modifications to resist anticipated flooding or increasing the urban tree canopy to provide cooling benefits that combat the urban heat island effect.

When protection or accommodation measures are insufficient adaptation options, *retreat strategies* provide an alternative approach.[33] These call for the removal of infrastructure and buildings from high-hazard areas and, where feasible, placing them elsewhere out of harm's way. Home

28. Matthew Bucchin & Aaron Tuley, *Planning for Climate Mitigation and Adaptation* 7 (American Planning Association, Planning Advisory Report No. 601, 2022).

29. *Id.* at 14.
30. *Id.* at 37.
31. *Id.*
32. *Id.*
33. *Id.*

buyouts in flood-prone coastal areas are an example of such a strategy. In contrast, *avoidance strategies* guide new development to occur out of harm's way at the onset.[34] This can be achieved through policy or incentives, such as siting standards that locate development away from steep slopes that may be prone to sediment disturbance and landslides in the face of heavy precipitation events in the future.

***b. Mitigation:* Does this strategy reduce or sequester GHG emissions?**

Mitigation strategies manage GHG emissions in two main ways: by *reducing or eliminating* emissions at the source and by *sequestering* existing GHGs from the atmosphere.[35]

The first way local municipalities can manage GHGs is by *reducing or eliminating* emissions at the source. According to WG III, "[s]trategies for established cities to achieve large GHG emissions savings include efficiently improving, repurposing or retrofitting the building stock, targeted infilling, and supporting non-motorized (e.g., walking, bicycling) and public transport."[36] Energy codes are a regulatory tool to reduce emissions from new and substantially renovated buildings. Localities can create high-density zoning districts and zones for mixed-use development. These tools reduce the amount of GHG emissions.

Another way municipalities can manage GHG emissions is to increase the capacity for *sequestration*, which allows for more GHGs to be captured from the atmosphere. Through biological sequestration, vegetated areas capture and store carbon, removing it from the atmosphere. CRD strategies include land use initiatives that preserve or expand the vegetated environment. Examples include rural communities that are stewards of their forests, meadows, and wetlands, and urban communities that increase their tree canopies and embed vegetation in their built environment.[37] Urban green infrastructure can take many forms, including bioswales, green roofs, and green streets.

***c. Equity:* Does this strategy include measures that explicitly consider and benefit vulnerable groups that disproportionately bear the burden of climate change?**

Currently, most local climate management strategies do not include language concerning equity.[38] This is likely because equity has not been a principal concern of local officials and stakeholders in many communities. In evaluating strategies for CRD compliance, look for any evidence of implementation techniques that benefit these groups. Evidence can be found in a strategy's Findings and Purpose sections, and the discussion of techniques used to solve the municipality's problems.

Identify language in the strategy that focuses on vulnerable communities, equity, outreach and priority areas, environmental and social justice, additional resources, a comprehensive and inclusive public participation process, accountability, and transparency. For example, an equitable comprehensive plan accounts for previous negative impacts of discrimination, and contains remedial strategies.[39] Additional examples include the use of racial impact statements for new policies and plans to ensure equitable results, and hazard mitigation plans (HMPs) that identify high-risk populations and explain how to ameliorate those impacts.[40]

Step 3: Methods to Ensure Resilience

***Key Question:* What methods exist in the strategy to ensure resilience?**

The search for resilience involves looking for measures that ensure timely recovery from climate change disturbances. Are there provisions that maintain and restore *social* cohesion and commitment within the community? Are there provisions that refer to the ability to recover from, withstand, and prevent disruptions to the local economy?[41] Are there provisions that focus on the health status of an *ecosystem* and its ability to bounce back after disturbances?[42]

An example of resilience can be made by contrasting the use of seawalls and living shorelines. Seawalls are constructed walls or embankments erected to prevent the sea from encroaching on an area of land.[43] Social, economic, and ecological resilience are absent in this strategy. This is because seawalls change the flow of sea waves, cause an increase in beach erosion, and are costly projects.[44] Living shorelines are an alternative, nature-based solution that use ecological systems to support and stabilize the shorelines. Living shorelines provide habitat for native species, improve water quality, and help stabilize the shorelines.

Step 4: Methods to Avoid Maladaptation

***Key Question:* What methods exist in the strategy to avoid maladaptation?**

In evaluating strategies, there is an obvious need to consult relevant science and to consider likely future consequences of climate change. Measures that require long-term monitoring and management can curb unintended, maladaptive consequences. It is important that municipalities, in constructing their strategies, consider possible maladaptations

34. *Id.*
35. *What Is a Carbon Sink?*, ClientEarth (Dec. 22, 2020), https://www.clientearth.org/latest/latest-updates/stories/what-is-a-carbon-sink/ ("A carbon sink is anything that absorbs more carbon from the atmosphere than it releases—for example, plants, the ocean, and soil.").
36. Jim Skea et al., *Summary for Policymakers*, *in* Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change 34 (Priyadarshi R. Shukla et al. eds., Cambridge Univ. Press 2022), https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_SPM.pdf.
37. IPCC, *supra* note 13, at 39.
38. Ian Reilly et al., *Centering Equity in Climate Change Resilience Planning: A Guide for Connecticut Municipalities* vii (last revised June 7, 2022), https://portal.ct.gov/-/media/DEEP/climatechange/GC3/GC3-2022-agendas-and-minutes/Centering-Equity-in-Climate-Change-Resilience-PlanningAGuide-for-Connecticut-Municipalities672022.pdf.
39. Rhea Mallett, *Equity-Based Comprehensive Plans (eCPs)—The First Generation*, 45 Zoning & Plan. L. Rep. 1, 4-6 (2022).
40. Anne Olson, *Racial Impact Analyses*, Pace Env't L.: GreenLaw Blog (Sept. 8, 2021), https://greenlaw.blogs.pace.edu/2021/09/08/racial-impact-analyses/.
41. U.S. Economic Development Administration, *supra* note 9.
42. *Id.*
43. John McCloy, *Sea Wall Guide: What Are the Advantages and Disadvantages?*, Green Coast (June 24, 2019), https://greencoast.org/sea-wall-advantages-and-disadvantages/.
44. *Id.*

and any potential ways to avoid unintended consequences. One example of maladaptation in the implementation of a land use strategy is the failure to analyze soil and hydrological conditions in tree canopy expansion areas.

Another example of a maladaptive strategy is a tree canopy expansion plan that relies solely on native tree species, without considering future climate conditions and unique soil conditions. While creating a native species planting guide is both an adaptive and mitigative measure, it may not account for foreseeable changes in climate. Certain native species may be less tolerant to these changes than other alternative species that are more attuned to future conditions. A strategy to combat this potential maladaptation is to adopt a species planting guide that is reviewed and adjusted periodically based on the best available science.

Step 5: Feasibility Analysis

Key Question 1: **What are the enabling conditions that make this strategy feasible?**

Evidence of conditions that enable the effectiveness and efficiency of a strategy can be found in political commitment and follow-through, institutional frameworks, policies and instruments with clear goals and priorities, enhanced knowledge on impacts and solutions, mobilization of and access to adequate financial resources, monitoring and evaluation, and inclusive governance processes. Enabling conditions often determine whether a particular adaptation option may be successfully implemented.

Key Question 2: **Is this strategy transferable to similar municipalities?**

Considerations for transferability include the degree of detail and depth of a strategy; how easily transferable and replicable a strategy is for other municipalities; the ability for a strategy to change and adapt over time; knowledge of a strategy's impact; barriers for implementation, maintenance, and monitoring; and adaptation gaps driven by widening disparities between the estimated costs of adaptation and documented finances allocated to adaptation.

V. Evaluation Examples: Case Studies

A. *Duck, North Carolina*

The town of Duck sits on North Carolina's Outer Banks, a collection of barrier islands along the coast of North Carolina.[45] In recent years, Duck has been subject to rising sea levels as well as severe and frequent flooding from coastal storms.[46] In response, Duck has used land use strategies to prevent flood damage. One strategy Duck has used is becoming a participant in the Federal Emergency Management Agency's (FEMA's) National Flood Insurance Program (NFIP) Community Rating System (CRS). The NFIP provides flood insurance to property owners, renters, and businesses, and helps them recover faster when floods occur.[47]

Through the NFIP, FEMA operates the CRS program, a voluntary incentive program that encourages community flood prevention strategies that exceed minimum NFIP standards.[48] To meet the NFIP's CRS eligibility requirements for discounted premiums, in May 2020, Duck updated its Flood Damage Prevention Ordinance. The objective of this ordinance is to promote public health, safety, and general welfare, and to minimize losses due to flood conditions in flood-prone areas by implementing provisions that are proactively designed to mitigate the damage from flooding.[49]

Duck's ordinance is adaptive to the future impacts of sea-level rise by requiring developers to obtain a permit prior to commencement of development, demonstrating that it conforms to the provisions of the ordinance.[50] This also establishes coastal high-hazard areas that are special flood hazard areas (SFHAs) as defined by FEMA.[51] SFHAs are areas that are especially prone to flooding, and in these areas, NFIP requirements must be enforced and flood insurance is required.

This ordinance does not mention any mitigation strategies to reduce GHG emissions. However, through the Building Resilient Infrastructure and Communities Program implemented by FEMA, Duck has received a $1.85 million grant for the construction of a living shoreline.[52] Living shorelines are a green infrastructure technique that uses biota to support and stabilize the shoreline and store large amounts of carbon.[53]

A major CRD deficit in Duck's ordinance is that there is no mention of equity. To improve this strategy, Duck should address and emphasize the importance of equity. To ensure economic and social resilience, §150.04(D) states that the town will work to prevent prolonged business losses and interruptions.[54] Additional objectives are that the town will work to ensure that rescue and relief efforts will occur without expense to the general public and minimize expenditures of public money for costly flood prevention projects. Duck has actively prepared for this maladaptation in §150.03(E), by stating that the town will "[p]revent or regulate the construction of flood barriers that will unnat-

45. U.S. News & World Report, *Outer Banks Travel Guide*, https://travel.usnews.com/Outer_Banks_NC/Area_Map/ (last visited Sept. 8, 2022).
46. Jeff Hampton, *OBX Town of Duck Looks to the Mountains for Help With Coastal Flooding*, Va. Pilot (Mar. 7, 2019), https://www.pilotonline.com/news/article_bf87a860-40e3-11e9-945a-afadbcb4d4ad.html.
47. FEMA, *Flood Insurance*, https://www.fema.gov/flood-insurance (last updated Mar. 9, 2022).
48. FEMA, *Community Rating System*, https://www.fema.gov/floodplain-management/community-rating-system (last updated June 17, 2022).
49. Duck, N.C., Ordinance 20-01, Updating Flood Damage Prevention Standards in the Town of Duck, N.C. (May 20, 2022), https://www.townofduck.com/wp-content/uploads/20-01-Updating-Flood-Damage-Prevention-Standards-Ordinance.pdf [hereinafter Ordinance 20-01].
50. *Id.*
51. *Id.* at 32; FEMA, *Flood Zones*, https://www.fema.gov/glossary/flood-zones (last updated July 8, 2020).
52. Jennifer Allen, *Duck Chosen for Living Shoreline, NC 12 Resiliency Project*, Coastal Rev. (Jan. 18, 2022), https://coastalreview.org/2022/01/duck-chosen-for-living-shoreline-n-c-12-resiliency-project/.
53. *Id.*
54. Ordinance 20-01, *supra* note 49, at 2.

urally divert flood waters which may increase flood hazards to other lands."[55]

The enabling conditions to make this strategy feasible are that in order to apply for NFIP funding, a FEMA-approved HMP is required. As a result, Duck maintains an HMP that requires an All Hazards Annual Report. The goals of the plan are updated every five years, and strategies to meet these goals are updated every summer.[56]

While the strategies used by the town of Duck have proven to be successful, they may not be transferable to other communities. Duck is fortunate to have an abundance of resources and ample community participation and support. Unfortunately, many communities that are affected by flooding are in low-income socioeconomic areas that do not have the resources or support to enact a large-scale program like Duck's.

B. Dover, New Hampshire/Cedar Rapids, Iowa

In 2019, the city of Dover, New Hampshire, revised its zoning code to include certain green development strategies that are consistent with CRD. The zoning code created various use districts, including a mixed-use central business district (CBD).[57] Building and street standards are designed to accommodate pedestrians and multimodal transportation.[58]

These provisions achieve most CRD objectives. Dover's code includes adaptive measures in response to climate change effects. Green roofs are required for commercial and mixed-use structures greater than 25,000 square feet. This is an accommodating adaptive measure to combat urban heat due to climate change by incorporating cooling vegetation into the existing built environment. The code provides techniques that mitigate GHG emissions by reducing the amount of emissions generated and by increasing the capacity of biological sequestration. All new buildings in the CBD must be solar-ready and any new commercial development greater than 25,000 square feet must include solar panels.[59]

Social and ecological resilience are implicitly found in Dover's code. The CBD encourages pedestrian-friendly neighborhoods, which is a placemaking strategy that exemplifies social resilience. Dover's *Streetscape Standards* require each green street to host and maintain certain species of canopy trees spaced out appropriately.[60] This is ecological resilience, as heightened forethought and planning went into the placement and selection of trees. The code includes provisions on maintenance, financing, and considerations for tree species, which are all enabling conditions that contribute to the plan's feasibility and transferability.[61]

But Dover's zoning code falls short on the equity component, which is common among many land use climate management strategies. A potentially transferable strategy that could be used to remedy this defect is found in the city of Cedar Rapids, Iowa, which successfully integrated equity into its novel reforestation plan.[62] Following a devastating tornado that wiped out 65% of the community's urban tree canopy in 2020, the Cedar Rapids local government paired up with the nonprofit sector to revitalize the tree population.[63] The plan includes equity and resilience goals; replicability is also a key component.[64]

Included in the Cedar Rapids program is the replanting of trees in neighborhoods, public parks, and along city streets. A Tree Equity Score identifies areas most in need of replanting.[65] Included in the priority canopy areas are those formerly redlined communities that historically had less tree cover.[66] In the first 10 years of ReLeaf, the city has a goal to plant and cultivate 1,700 trees each year, beginning with the identified priority areas.[67] This project places an emphasis on equity that is rarely seen.

C. New York, New York

Zoning for Coastal Flood Resiliency (ZCFR) is a package of rules, adopted by the City of New York in May 2021, that aims to promote resilience across current and future floodplains.[68] With 520 miles of coastline, much of New York City is susceptible to the coastal impacts of climate change, such as sea-level rise, flooding, erosion, and the increased frequency and severity of volatile storm events. These citywide changes allow zoning to be more supportive of resilience in the face of these climate-related impacts.

The ZCFR is not a product that was created in the silos of local government planning offices; rather, it emerged from four years of dedicated community engagement and a rigorous public participation process involving more than 200 meetings hosted by the city's Department of City Planning.[69] What emerged is a series of complementary rules that address four goals: (1) encourage resiliency throughout the current and future floodplains; (2) support the long-term resilient design of all building types; (3) allow for adaptation over time through incremental ret-

55. *Id.*
56. Town of Duck, North Carolina, *Hazard Mitigation Planning*, https://www.townofduck.com/frequently-visited/community-development/hazard-mitigation-planning/ (last updated Aug. 8, 2022).
57. Dover, N.H., Zoning §170-7(E)(3)(e) (2021), https://ecode360.com/attachment/DO0878/Misc.%20Documents%20-%20Zoning%20-%20as%20amended%2010.13.2021.pdf.
58. *Id.* §170-20(E)(1).
59. *Id.* §170-20(F)(3)(f)(i).
60. *Id.* §170-20(E)(3)(a)(i).
61. *Id.*
62. Cedar Rapids, Iowa, *ReLeaf Cedar Rapids*, https://www.cedar-rapids.org/residents/parks_and_recreation/releaf_cedar_rapids_.php (last visited Sept. 20, 2022).
63. *Id.*
64. *Id.*
65. *Id.*
66. *Id.*
67. *Id.*
68. *See* City of New York, Land Use Committee of City Council, Zoning for Coastal Flood Resiliency (Apr. 28, 2021), https://www1.nyc.gov/assets/planning/download/pdf/plans-studies/flood-resiliency-update/adopted-text-0521.pdf [hereinafter ZCFR].
69. NYC Planning, Zoning for Resiliency: Community Outreach Summary (2018), https://www1.nyc.gov/assets/planning/download/pdf/plans-studies/climate-resiliency/outreach-summary.pdf.

rofits; and (4) facilitate future recovery by reducing regulatory obstacles.

One of the key zoning actions in the ZCFR expands where flood-resilient zoning applies by including projected future flood-prone areas (i.e., areas that are expected to have a 1% chance of flooding each year, by the year 2050). By including these future flood-prone neighborhoods, the number of buildings that will be held to resilient building standards—either in new construction or retrofitting existing structures—increases by 50%. For areas in these current and future flood zones, the ZCFR provides flood-resistant construction standards with flexible rules on building heights and setbacks so structures can be raised and vegetated streetscapes (featuring species tolerant to salt and inundation)[70] can be expanded. To make this feasible, the ZCFR includes provisions promoting incremental retrofits; this allows for structures and streetscapes to transition into their adaptive and mitigative capacity without requiring a complete rebuild.

The ZCFR also allows for an expedited recovery process by placing provisions in the Zoning Resolution that reduce regulatory obstacles such as drawn-out permitting processes. This allows for timely decisionmaking and action in the face of a disaster recovery period. Notably, the rigorous public participation process looked to advance climate and racial justice by placing vulnerable and minority communities at the forefront of these climate management strategies. By integrating equity across adaptation and mitigation measures, the ZCFR looks to be a highly evolved CRD strategy that aims for a manageable, feasible rollout with bottom-up and top-down support for implementation.

D. *Philadelphia, Pennsylvania*

In 2011, the Philadelphia Water Department (PWD) introduced the Green City, Clean Waters plan.[71] The plan seeks to reduce overflow from the city's combined sewer systems into local streams and rivers during moderate to heavy rainfall events, which has caused the degradation of streams and the Delaware and Schuylkill Rivers. The initiative is included in Philadelphia's comprehensive plan, and relies on financial incentives, assistance programs, and stormwater regulations to support implementation.[72]

The plan utilizes a green stormwater infrastructure-based approach, combined with stream corridor restoration and preservation, to drastically reduce the volume of stormwater runoff.[73] The PWD committed $1.6 billion over the course of the 20-year implementation period, in addition to adopting other programs to reduce combined sewer overflow. The full investment in the Green City, Clean Waters plan is anticipated to exceed $3 billion.

The Green City, Clean Waters plan touches on all three key objectives of CRD. It allows the city to adapt to climate change because it responds to increased runoff from more dramatic weather events and increased precipitation. Green stormwater infrastructure will also reduce the urban heat island effect, which is projected to prevent approximately 140 deaths over the next 40 years.[74] Green City, Clean Waters is estimated to prevent five to eight billion gallons of combined sewer overflow per year.[75] In addition to the adaptation benefits, the green stormwater infrastructure is projected to offset or prevent 1.5 billion pounds of carbon dioxide emissions, which is consistent with the IPCC's definition of mitigative measures.[76]

While Philadelphia's plan includes social benefits, it fails to include language and objectives that explicitly address vulnerable populations. The plan states that green infrastructure will enhance recreation, improve community quality of life, and improve property values in greened neighborhoods. To better incorporate equity, the plan could identify low-income and vulnerable neighborhoods that are disproportionately affected by climate change and urban heat.

E. *Denver, Colorado*

On November 3, 2020, the people of the county of Denver voted to create the Climate Protection Fund (CPF).[77] From revenues derived by a 0.25% sales tax, the fund raises $40 million annually dedicated to funding programs that reduce GHG emissions and adapt to climate change.[78] Denver has six allowable uses for the fund, four of which are directly related to the municipality's land use controls. Those four allowable uses are (1) increased investments in solar power, battery storage, and other renewable energy sources; (2) adaptation and resiliency programs that help vulnerable communities prepare for a changing climate; (3) programs and services that provide affordable, clean, safe, and reliable transportation choices; and (4) upgrades to the energy efficiency of homes, offices, and industry to reduce their carbon footprint, utility bills, and indoor air pollution.[79]

These allowable uses are directly related to achieving a variety of goals from Denver's comprehensive land use plan. The most applicable goals are mitigating climate impacts, preparing and adapting to climate change, expanding green infrastructure, and expanding multimodal infrastructure.[80] In sum, Denver is using the CPF to support

70. The ZCFR provides specific requirements for new vegetation and tree planting in public areas. Species selection prioritizes "plants suited for waterfront conditions and include[s] a diversity of species with emphasis on native plants." *See* ZCFR, *supra* note 68, at 47.
71. *See* PWD, Green City, Clean Waters: The City of Philadelphia's Program for Combined Sewer Overflow Control (2011), https://www.phila.gov/media/20160421133948/green-city-clean-waters.pdf.
72. *Id.* at 3-4; PWD, *Regulations*, https://www.pwdplanreview.org/stormwater-101/regulations (last visited Sept. 8, 2022).
73. PWD, *supra* note 71, at 2.
74. *Id.* at 19.
75. *Id.*
76. *Id.*
77. Denver Office of Climate Action, Sustainability, and Resilience, *supra* note 21, at 10.
78. *Id.*
79. *Id.* at 5.
80. City and County of Denver, Comprehensive Plan 2040: Denver's Plan for the Future 18, https://www.denvergov.org/files/assets/public/community-planning-and-development/documents/planning-general/

physical projects that ultimately achieve the goals of the comprehensive plan.

In 2019, Colorado established a minimum building energy code.[81] This law requires local jurisdictions to adopt one of the three most recent versions from the International Energy Conservation Code.[82] Since energy codes cannot require compliance in existing buildings, Denver can use the CPF as an incentive to improve the energy efficiency of those buildings. An example of this is the Healthy Affordable Home Electrification Program. The program provides electrification upgrades, energy-efficiency services, and weatherization upgrades, and ensures that under-resourced families with chronic respiratory conditions are prioritized as recipients of the funding.[83] This is just one example of how Denver is using the CPF in conjunction with land use tools to meet the goals of their comprehensive plan.

The comprehensive plan and the CPF aim to achieve both adaptation and mitigation, incorporate equity and resilience, and avoid maladaptation through yearly monitoring and budget planning. Denver's CPF may be used as a model for other municipalities, with similar resources, for how they can use strategic funding, with a focus on equity, to make CRD strategies successful.

VI. Conclusion: As the Climate Transforms, So Must Governance

WG I of the IPCC has provided extensive scientific evidence that the pace of climate change is rapid and, frankly, frightening. "The scale of recent changes . . . [is] unprecedented over many centuries to many thousands of years."[84] For example, levels of atmospheric carbon dioxide, the most prominent GHG, exist in greater concentrations today than in the previous two million years.[85]

Since 1970, global surface temperature has increased at a greater rate than at any point over the past 2,000 years.[86] "Global mean sea level has risen faster since 1900 than over any preceding century in at least the last 3000 years."[87] Evidence of observed changes in extremes such as heat waves, heavy precipitation, droughts, and tropical cyclones, and, in particular, their attribution to human influence, has strengthened since the IPCC's previous report in 2014.[88]

The challenge to local governments is not just the worsening climate, but also the effort required to achieve CRD itself. These challenges require nothing less than a transformation in governance. Local, state, and federal law and policymakers must better understand the system within which climate change occurs and their role within that system. Local collaborators in the civic and private sectors are necessary partners with state and federal agencies to combat this global issue. CRD's key components require governments to take a broader and deeper view of their role, responsibilities, and whom to consult.[89]

Local governments will find themselves in a number of novel engagements to address climate issues. Vulnerability studies must be done, leaders of vulnerable neighborhoods must be meaningfully consulted, and historical inequities must be understood and accounted for.[90] Adaptive measures taken today must be informed by science to ensure they are suited to tomorrow's climate. Resilience requires an understanding of the capacity of the human, ecological, and economic systems to rebound following catastrophic damage. For many localities, these challenges are wholly new, beyond their existing technical and financial capacities, and require assistance from necessary actors locally and within the federal system.

We close with three essential takeaway lessons that the complexities of climate change and CRD teach:

1. Using this or a similar evaluation system, local officials and stakeholders can and should begin the process of adopting CRD and its components in their climate management strategies and land use plans and, in the process, learn more about the collaboration needed horizontally at the local level and vertically at the state, federal, and global levels.

comprehensive-plan/denver_comprehensive_plan_2040_city_council_draft.pdf.

81. Colorado Energy Office, *Building Energy Codes*, https://energyoffice.colorado.gov/climate-energy/energy-policy/building-energy-codes (last visited Sept. 8, 2022).
82. *Id.*
83. Denver Office of Climate Action, Sustainability, and Resilience, *supra* note 21, at 47.
84. IPCC, *Summary for Policymakers*, *in* Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change 8 (Valérie Masson-Delmotte et al. eds., Cambridge Univ. Press 2021), https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM.pdf.
85. *Id.*:

> In 2019, atmospheric CO_2 [carbon dioxide] concentrations were higher than at any time in at least 2 million years . . . , and concentrations of CH_4 [methane] and N_2O [nitrous oxide] were higher than at any time in at least 800,000 years . . . Since 1750, increases in CO_2 (47%) and CH_4 (156%) concentrations far exceed—and increases in N_2O (23%) are similar to—the natural multi-millennial changes between glacial and interglacial periods over at least the past 800,000 years . . . .

86. *Id.*
87. *Id.*:

> The global ocean has warmed faster over the past century than since the end of the last deglacial transition (around 11,000 years ago). A long-term increase in surface open ocean pH occurred over the past 50 million years. However, surface open ocean pH as low as recent decades is unusual in the last 2 million years.

88. IPCC, *supra* note 84, at 8.
89. The IPCC stated:

> Appropriate design of policies, institutions and governance systems at all scales can contribute to land-related adaptation and mitigation while facilitating the pursuit of climate-adaptive development pathways . . . . Mutually supportive climate and land policies have the potential to save resources, amplify social resilience, support ecological restoration, and foster engagement and collaboration between multiple stakeholders . . . .

IPCC, *Summary for Policymakers*, *in* Climate Change and Land: An IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems 29 (Priyadarshi R. Shukla et al. eds., 2019), https://www.ipcc.ch/site/assets/uploads/sites/4/2020/02/SPM_Updated-Jan20.pdf.

90. IPCC, *supra* note 1, at 32.

2. Shifting policy thinking, from a siloed focus on addressing one issue at a time to realizing the process of seeking out and working with needed actors across horizontal and vertical axes, is how the connective tissue that builds resilience is developed and strengthened. This process and focus can result in the transformative changes needed to keep up with the alarming velocity of climate change.

3. WG II's emphasis on enabling conditions is prescient. By focusing on its definition, the transformation in governance needed is clarified. These are conditions that are necessary for "implementing, accelerating, and sustaining adaptation in human systems and ecosystems."[91] The definition includes political commitment and follow-through, institutional frameworks including all necessary actors, creation of clear goals and priorities, enhanced knowledge on impacts and solutions, adequate financial resources, and inclusive governance processes.

91. *Id.* at 29.