

Table 1: Example financial impacts from climate-related risks and opportunities

POTENTIAL IMPACTS FROM PHYSICAL RISKS	
<p>Assets</p> <ul style="list-style-type: none"> • write-down of asset value (including unvalued natural assets) • reduced useful life <p>Expenses: Operations and Capital Expenditures</p> <ul style="list-style-type: none"> • operational expenses <ul style="list-style-type: none"> – asset replacement costs – additional maintenance costs – higher heating/cooling costs for government buildings – emergency provision of critical services – reduced employee productivity – reduced operational capacity of assets and technologies – additional public service needs – costs associated with disaster/recovery grant writing and implementation – higher costs to ensure worker safety 	<p>Expenses: Operations and Capital Expenditures (cont.)</p> <ul style="list-style-type: none"> • impacts on the capital budget <ul style="list-style-type: none"> – upgrade and retrofit costs – new infrastructure investment costs – relocation expenses • other financial impacts <ul style="list-style-type: none"> – increasing borrowing costs or liquidity thresholds – changing insurance liabilities, premiums, and coverage <p>Revenues: Taxes and Service Revenues</p> <ul style="list-style-type: none"> • declining property tax revenues • negative impacts on sales and hospitality tax revenues • insufficient service revenues
POTENTIAL IMPACTS FROM TRANSITION RISKS	
<p>Assets</p> <ul style="list-style-type: none"> • stranded assets (a particular concern for communities with municipally-owned utilities) • early asset retirements <p>Expenses: Operations and Capital Expenditures</p> <ul style="list-style-type: none"> • costs to develop and manage new policy and programs • new training costs • pension liabilities • operational and capital costs for municipally-owned utilities <p>Revenues: Taxes and Intergovernmental Disbursements</p> <ul style="list-style-type: none"> • reduced tax revenues • reduced state and federal disbursements tied to fossil-fuel extraction 	
POTENTIAL IMPACTS FROM CLIMATE-RELATED OPPORTUNITIES	
<p>Assets</p> <ul style="list-style-type: none"> • protected useful life of assets <p>Expenses: Operations and Capital Expenditures</p> <ul style="list-style-type: none"> • reduced operational expenses across a variety of activities • improved credit rating and reduced costs to borrow • longer asset lifetime <p>Revenues: Taxes, Service Revenues, Grants, and Contributions</p> <ul style="list-style-type: none"> • greater access to state and federal dollars • increased tax and service revenues • increased revenue streams • new revenue streams from innovative climate financing 	

Table 2: Resources for Physical Climate Hazard Identification

RESOURCE NAME	RESOURCE PROVIDER	RESOURCE TYPE	DESCRIPTION
<i>National Climate Assessment</i> ¹	United States Global Change Research Program (USGCRP)	Information	National Climate Assessment provides the state-of-the-science synthesis of climate impacts and trends that can be used by policymakers to understand regional trends and projections and potential impacts in different climate scenarios.
<i>U.S. Climate Resilience Toolkit</i> ²	National Oceanic and Atmospheric Administration (NOAA)	Tool Library	The U.S. Climate Resilience Toolkit website is designed to help users find and use tools, information, resilience framework and subject matter expertise to build climate resilience. The tools also offer region-specific climate baseline and projection overviews.
<i>The Climate Explorer</i> ³	NOAA	Mapping Tool	The Climate Explorer tool provides county-level climate conditions including temperature, precipitation and others projected through 2099. The tool is available through the U.S. Climate Resilience Toolkit.
<i>Climate Resilience Evaluation and Awareness Tool (CREAT)</i> ⁴	Environmental Protection Agency (EPA)	Mapping Tool	CREAT provides drinking water, wastewater, stormwater utility owners and operators with scenario-based climate change projections for temperature, precipitation, storms, extreme heat and sea level.
<i>Extreme Water Levels</i> ⁵	NOAA	Mapping Tool	Extreme Water Levels map provides annual and monthly exceedance probability levels for select NOAA Center for Operational Oceanographic Products and Services (CO-OPS) water level stations with at least 30 years of data.
<i>Flood Insurance Rate Maps</i> ⁶	Federal Emergency Response Agency (FEMA)	Mapping Tool	The Flood Insurance Rate Maps provide data to identify flood hazards and assess flood risk at the community level. The maps are part of FEMA's Risk Mapping, Assessment, and Planning (Risk MAP) program.
<i>Sea Level Rise Viewer</i> ⁷	NOAA	Mapping and Visualization Tool	Sea Level Rise Viewer provides visualization of community-level impacts from coastal flooding or sea level rise. Photo simulations of how future flooding might impact local landmarks are provided, as well as data related to water depth, connectivity, flood frequency, socio-economic vulnerability, wetland loss and migration, and mapping confidence.
<i>Wildfire Risk to Communities</i> ⁸	United States Department of Agriculture (USDA)	Mapping Tool	Wildfire Risk to Communities website includes interactive maps to help cities understand their wildfire risk. Direct and indirect exposure type, wildfire likelihood and vulnerable populations are provided in these maps.

Table 3: Resources for Physical Climate Vulnerability and Risk Assessments

RESOURCE NAME	RESOURCE PROVIDER	RESOURCE TYPE	DESCRIPTION
<i>Climate Risk and Adaptation Framework and Taxonomy (CRAFT)</i> ⁹	C40 Cities and Arup	Framework	CRAFT is a standardized reporting framework that enables cities to perform robust and consistent reporting of local climate hazards and impacts, risk and vulnerability assessment, and adaptation planning and implementation as part of their compliance with the Compact of Mayors.
<i>Climate Change Risk Assessment Guidance</i> ¹⁰	C40 Cities	Guidance	Climate Change Risk Assessment Guidance aids cities in developing a climate risk assessment report, including methodology and components of the assessment. The focus of this guidance is on compatibility with C40 and Global Covenant of Mayors requirements.
<i>Infrastructure Interdependencies and Climate Risks report</i> ¹¹	C40 Cities	Guidance	This report describes the approaches used by a selection of city governments to identify their infrastructure interdependencies and climate impacts on these systems, as a first step in reducing systemic risks.
<i>Assessing Health Vulnerability to Climate Change: A Guide for Health Departments</i> ¹²	Centers for Disease Control and Prevention (CDC)	Guidance	This guide helps health departments assess local vulnerabilities to the health hazards associated with climate change.
<i>The TNFD Nature-related Risk and Opportunity Management and Disclosure Framework Beta v0.3 Annex 3.2</i> ¹³	Task Force on Nature-Related Financial Disclosures (TNFD)	Guidance	The TNFD guidance on how to understand and respond to nature-related risks and opportunities. The loss of ecosystem services could represent substantial nature-related risk to governments. Wetlands, for example, provide extensive ecosystem services, notably disaster risk resilience.
<i>Temperate</i> ¹⁴	ICLEI-USA	Planning Tool	Temperate tool is built for small- to medium- sized cities to identify climate hazards, assess vulnerabilities, and build an adaptation plan. The indicator data covers the majority of cities and towns across the United States.
<i>Neighborhoods at Risk</i> ¹⁵	Headwaters Economics	Mapping Tool	Neighborhoods at Risk tool uses U.S. Census Bureau data to map all neighborhoods linking socioeconomic data to climate vulnerabilities to understand which communities are most at risk.
<i>National Risk Index Map</i> ¹⁶	FEMA	Planning Tool	National Risk Index Map provides both county and census tract-level data that includes expected annual loss due to natural hazards, social vulnerability, and community resilience.
<i>Aqueduct</i> ¹⁷	World Resources Institute	Mapping Tool	The Aqueduct tools use open-source, peer-reviewed data to map baseline and future water-related risks such as water stress and coastal flooding risk.
<i>Risk Factor – Flood & Fire</i> ¹⁸	First Street Foundation	Mapping Tool	The Risk Factor tool visualizes flood and wildfire risk at the property level across the United States for historic, current, and future risk projections.

Table 4: Resources for Assessing Climate-Related Financial Risk and Opportunity

RESOURCE NAME	RESOURCE PROVIDER	RESOURCE TYPE	DESCRIPTION
<i>"ESG" Best Practice - "E" Environmental</i> ¹⁹	Government Finance Officers Association	Guidance	Best Practice guidance provides environmental disclosure considerations for governments including primary risks identified and policy actions taken for the broader municipal market.
<i>Enhancing Climate-related Disclosure by Cities: A Guide to Adopting the Recommendations of the Task Force on Climate-related Financial Disclosures</i> ²⁰	Chartered Professional Accountants of Canada	Guidance	This guide has been developed to enhance the transparency of a city's climate-related risks and opportunities, strategies, and governance in line with TCFD recommendations. This guide is designed to help cities determine what climate-related information is valuable for internal decision-making to support short-term budgeting and long-term capital planning. It is also intended to enhance the usefulness of a city's general-purpose financial reports for external stakeholders.
<i>Municipal Natural Assets Initiative</i> ²¹	Municipal Natural Assets Initiative	Initiative	This initiative partnered with KPMG and a university and Canadian cities to develop a non-binding initiative that values natural assets and informs public sector accounting standards board.
<i>Hazus</i> ²²	FEMA	Planning Tool	This tool is a part of FEMA's methodology for estimating potential losses from disasters and is a model that estimates potential losses from climate hazards such as earthquakes, floods, and hurricanes.
<i>Climate Budget</i> ²³	C40 Cities	Planning Tool	Climate Budgeting tools can be used to support transition risk assessment/greenhouse gas mitigation goals that can be integrated into a city's daily operations and policies.
<i>Co-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA)</i> ²⁴	EPA	Planning Tool	The COBRA screening model allows cities to explore how changes in policies and programs can affect human health, estimate the economic value of health benefits, and map air quality, human health, and health-related economic benefits resulting from clean energy policies and programs.
<i>City Performance Tool (CyPT) Portal</i> ²⁵	Siemens	Planning Tool	The CyPT Portal helps city representatives and decision-makers determine the impact of technologies on city emissions reductions targets. Cities can explore the environmental and economic benefits of infrastructure choices in energy, building, and transport.

REFERENCES

- 1 David Reidmiller et al., *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* (Washington, DC: USGCRP, 2018), <https://nca2018.globalchange.gov/chapter/front-matter-about/>.
- 2 “U.S. Climate Resilience Toolkit”, U.S. Climate Resilience Toolkit, accessed January 13, 2023, <https://toolkit.climate.gov/#tools>.
- 3 “The Climate Explorer”, U.S. Federal Government, accessed January 13, 2023, <https://crt-climate-explorer.nemac.org/>.
- 4 “CREAT Climate Change Scenarios Projection Map”, United States Environmental Protection Agency, accessed January 13, 2023, <https://www.epa.gov/crwu/climate-resilience-evaluation-and-awareness-tool-creat-risk-assessment-application-water>.
- 5 “Extreme Water Levels”, National Oceanic and Atmospheric Administration, accessed January 13, 2023, <https://tidesandcurrents.noaa.gov/est/>.
- 6 “Flood Insurance Rate Map (FIRM)”, Federal Emergency Management Agency, accessed January 13, 2023, <https://www.fema.gov/glossary/flood-insurance-rate-map-firm>.
- 7 “Sea Level Rise Viewer”, National Oceanic and Atmospheric Administration, accessed January 13, 2023, <https://coast.noaa.gov/slr/>.
- 8 “Wildfire Risk to Communities”, USDA, accessed January 13, 2023, <https://wildfirerisk.org/>.
- 9 “Climate Risk and Adaptation Framework and Taxonomy (CRAFT)”, Global Covenant of Mayors for Climate & Energy, accessed January 13, 2023, <https://www.globalcovenantofmayors.org/>.
- 10 C40 Cities, *Climate Change Risk Assessment Guidance*, https://cdn.locomotive.works/sites/5ab410c8a2f42204838f797e/content_entry5ab410fb74c4833febe6c81a/5b17dd2614ad660612c5dc54/files/C40_Cities_Climate_Change_Risk_Assessment_Guidance.pdf?1541689629.
- 11 C40 Cities, *Infrastructure Interdependencies + Climate Risks Report*, https://assets.locomotive.works/sites/5ab410c8a2f42204838f797e/content_entry5ab410fb74c4833febe6c81a/5ad4fd8574c4837def5d3f8a/files/C40_Interdependencies_TOOL.pdf?1528290641.
- 12 CDC, *Assessing Health Vulnerability to Climate Change: A Guide for Health Departments*, <https://www.cdc.gov/climateandhealth/pubs/assessing-healthvulnerabilitytoclimatechange.pdf>.
- 13 “TNFD Framework,” Taskforce on Nature-related Financial Risk, accessed January 13, 2023, <https://framework.tnfd.global/>.
- 14 “Temperate,” ICLEI USA, accessed January 13, 2023, <https://temperate.io/subscription>.
- 15 “Neighborhoods at Risk,” Headwaters Economics, accessed January 13, 2023, <https://nar.headwaterseconomics.org>.
- 16 “National Risk Index for Natural Hazards,” Federal Emergency Management Agency, accessed January 13, 2023, <https://www.fema.gov/flood-maps/products-tools/national-risk-index>.
- 17 “Aqueduct,” World Resources Institute, accessed January 13, 2023, <https://www.wri.org/aqueduct>.
- 18 “Risk Factor,” First Street Foundation, accessed January 13, 2023, <https://riskfactor.com/>.
- 19 “‘ESG’ Best Practice - ‘E’ Environmental,” Government Finance Officers Association, last modified March 8, 2021, <https://www.gfoa.org/materials/esg-best-practice-e-environmental>.
- 20 “A Guide to Adopting the TCFD Recommendations for Cities,” Chartered Professional Accountants Canada, accessed December 30, 2022, <https://www.cpacanada.ca/en/business-and-accounting-resources/financial-and-non-financial-reporting/sustainability-environmental-and-social-reporting/publications/tcfd-guide-for-cities>.
- 21 “Municipal Natural Assets Initiative,” MNAI, accessed January 13, 2023, <https://mnai.ca/>.
- 22 “FEMA Flood Map Service Center: Hazus,” Federal Emergency Management Agency, accessed January 13, 2023, <https://msc.fema.gov/portal/resources/hazus>.
- 23 “Climate budgets: Why your city needs one,” C40 Cities, accessed January 13, 2023, https://www.c40knowledgehub.org/s/article/Climate-budgets-why-your-city-needs-one?language=en_US.
- 24 “CO-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA),” EPA, accessed January 13, 2023, <https://cobra.epa.gov/>.
- 25 “City Performance Tool,” Siemens, accessed January 13, 2023, <https://new.siemens.com/global/en/products/services/iot-siemens/public-sector/city-performance-tool.html>.