

REGULATORY IMPERATIVE TO ENSURE UTILITY CLIMATE RESILIENCE PLANNING

DON'T LOOK UP!
Adam McKay
(Title of Last Movie Made
Before Comet Destroyed Earth)

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Synopsis: Climate change has pushed our planet beyond the tipping point. The consequences are already upon us in the form of rising sea levels and more frequent and extreme weather events, wildfires, flooding, and drought, despite ongoing efforts to reduce carbon emissions. Decarbonization efforts are not futile, as they can still prevent a climate catastrophe, but adaptive measures are needed to protect critical public utility infrastructure and maintain essential services. This article asserts that the necessary predictive tools are available for utilities to engage in climate resilience planning, that market forces (evidenced by insurance coverage and premiums and bond ratings) confirm the imperative for planning, and that state and local regulators that oversee and incentivize utility performance have the responsibility and authority to tackle this critical policy issue.

As commissions are charged with ensuring the provision of *safe, adequate,* and *reliable* utility services at a reasonable cost, regulators can deploy long-standing prudence principles to mandate utility action and penalize utility inaction regarding known weather-related risks affecting service continuity. The regulatory toolkit is not limited to reactive measures. Regulatory commissions have broad rulemaking powers that they can utilize to impose requirements for resilience planning and principled ratemaking tools for climate resilience cost recovery.

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I. THE ISSUE

The toll of climate change and extreme weather events on public utility infrastructure and operations totals billions of dollars annually.[1] Although we focus here mainly on electricity utilities and, to some extent, the water sector, climate change poses risks to all utility infrastructure, including natural gas, communications, and transportation networks. The federal government has issued a clear call to action for utility climate change resilience. In 2016, the Department of Energy published comprehensive utility guidelines for vulnerability assessment and resilience planning.[2] A January 2020 report by the Government Accountability Office (GAO) pointed to the threat that climate change poses to "utilities that produce drinking water and treat wastewater, emphasizing the availability of "federal technical and financial assistance to make such infrastructure more resilient to extreme weather," and recommending that the U.S. Environmental Protection Agency (EPA) organize a network of technical advisors to help prepare water utility infrastructure.[3] A March 2021 GAO report on electricity grid resilience found that climate change "could affect every aspect of the grid from generation, transmission, and distribution to demand for electricity . . . [and] could cost utilities and customers billions, including the costs of power outages and infrastructure damage."[4]

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1. *See* Yannic Rack, *Utilities Face Greatest Threat as Climate Risks Intensify*, S&P GLOBAL (Sept. 20, 2022), https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/utilities-face-greatest-threat-as-climate-risks-intensify-66613890.

2. U.S. DEP'T OF ENERGY, CLIMATE CHANGE AND THE ELECTRICITY SECTOR: GUIDE FOR CLIMATE CHANGE RESILIENCE PLANNING (2016), https://toolkit.climate.gov/sites/default/files/Climate%20Change%20and%20the%20Electricity%20Sector%20Guide%20for%20Climate%20Change%20Resilience%20Planning%20September%202016_0.pdf.

3. U.S. GOV. ACCOUNTABILITY OFFICE, WATER INFRASTRUCTURE: TECHNICAL ASSISTANCE AND CLIMATE RESILIENCE PLANNING COULD HELP UTILITIES PREPARE FOR POTENTIAL CLIMATE CHANGE IMPACTS (Jan. 2020), https://www.gao.gov/assets/d2024a.pdf.

4. U.S. GOV. ACCOUNTABILITY OFFICE, ELECTRICITY GRID RESILIENCE: CLIMATE CHANGE IS EXPECTED TO HAVE FAR REACHING EFFECTS (Mar. 2021),

The accelerating risks, impacts, and costs to utilities from climate change beg several questions that utility policymakers, regulators, and managers should be asking.[5] Are public utilities developing and implementing adaptive climate-change resilience plans? Are state regulatory commissions and other responsible oversight entities sufficiently focused on requirements and rules for resilience planning? How does the time-sensitive imperative of resilience planning square with the public interest and the long-standing and codified utility obligations under the regulatory compact to provide *safe, adequate, and reliable* service in exchange for their enfranchised monopolies?[6] In short, are utilities required to take steps to ensure secure and uninterrupted public utility service, and are they doing so?

A. Reasons or Rationales?

A 2020 study by Columbia University's Sabin Center (Sabin) and the Environmental Defense Fund (EDF) found that while studies have shown that "accurate, specific, and actionable climate resilience planning is possible . . . relatively few electric utilities have engaged in the process."[7] Some of the explanations offered were as follows (emphases added):[8] [9]

- "[C]limate change is often perceived as involving greater *unknowns.* Many electric utilities appear to view climate resilience planning as akin to an exercise in conjecture."
- "Other electric utilities have cited *limited data* availability as a hindrance to climate resilience planning."
- "[E]lectric utilities often have to engage consultants or other researchers to develop localized climate data that meets their needs which can be *costly*."
- "[W]ill they be permitted to *recover* the potentially significant costs incurred in the planning process?"

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5. *See* Roshi Nateghi, et al., *Past The Tipping Point: How Regulators and Utilities Are and Will Be Looking At Ways to Mitigate the Inevitable Impacts of Climate Change*, 43 ENERGY L.J. 190 (2022), https://www.eba-net.org/wp-content/uploads/2023/02/8-Climate-Symposium-191-222.pdf; *World Headed for Climate Catastrophe Without Urgent Action: UN Secretary General*, UN ENV'T PROGRAMME (Oct. 2022), https://www.unep.org/news-and-stories/story/world-headed-climate-catastrophe-without-urgent-action-un-secretary-general.

6. For an exhaustive history of the service obligations of public utilities under utility regulation, from its origins in early British common law to contemporary statutory and regulatory mandates, *see* Jim Rossi, *The Common Law "Duty to Serve" and Protection of Consumers in an Age of Competitive Retail Public Utility Restructuring*," 52 V. AND L. REV. 1233 (1998).

7. Romany Webb et al., *Climate Risk in the Electricity Sector: Legal Obligations to Advance Climate Resilience Planning by Electric Utilities,* COLUM. L. SCH. (Dec. 2020), https://scholarship.law.columbia.edu/cgi/viewcontent.cgi?article=1043&context=sabin_climate_change.

8. *Id.* at 10, 23.

9. A less benign view is that utilities and associated fossil-fuel industries have engaged in political strategies to thwart climate action individually or through their trade organizations. *See, e.g.,* LEAH STOKES, SHORT CIRCUITING POLICY: INTEREST GROUPS AND THE BATTLE OVER CLEAN ENERGY AND CLIMATE POLICY IN THE AMERICAN STATES (2020).

- "[W]ill they be permitted to recover the much *larger costs* associated with implementing resilience measures that planning demonstrates are advisable?"
- "Even if electric utilities are permitted to recover resilience investments, the regulatory lag—i.e., the gap between when the investments are made and when cost recovery occurs—could undermine their *financial viability*."

Considerable effort has been devoted to holding to account those responsible for climate change and its impacts. Leading works include the event attribution work pioneered by Myles Allen in *Liability for Climate Change*[10] and the empirical research of Friedrike Otto and others,[11] which has been cited in climate-related litigation.[12] This article focuses on the need for comprehensive resilience planning and the related role of regulators in promoting planning, as also highlighted in the Sabin-EDF study.

But utilities also continue to face financial risks if they do not take distinct but related actions to mitigate the effects of climate change. Utilities are subject to potential exposure to administrative, civil, or even criminal liabilities for service interruptions or damages attributable to climate change, notwithstanding the adoption and implementation of approved resilience plans. Increasingly, individual plaintiffs or members of a class are making claims against their public utilities for compensatory damages or injunctive relief for failing to adapt and become climate-change resilient.[13]

Some progress has been made since the Sabin-EDF study. An Edison Electric Institute survey reports that in 2022, "adaptation, hardening, and resilience" drove 12% of distribution and 7% of transmission investments, totaling about $30 billion annually in recent years.[14] But, many utilities still have not undertaken meaningful and proportionate resilience planning in the face of climate change and extreme

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10. Myles Allen, *Liability for Climate Change*, 421 NATURE 891 (2003)*; see also,* Michael Faure and Marjan Peeters, *Liability and Climate Change*, CLIMATE SCI. (2019).

11. *See* Fredericke Otto et al., *Causality and the fate of climate litigation: The role of social superstructure narrative*, 13 GLOBAL POLICY 736 (2022) (assessing the viability of future climate change litigation).

12. *See* Kate Selig, *Youths Sued Montana Over Climate Change and Won. Here's Why it Matters*, WASH. POST (Aug. 16, 2023), https://www.washingtonpost.com/climate-environment/2023/08/17/montana-climate-lawsuit-impact/*; see also* Held v. Montana, Cause No. CDV-2020-307 (MT First Judicial Dist. Ct. Aug. 14, 2023).

13. *See* Otto et al., *supra* note 11; Webb et al., *supra* note 7, at 16-38.

14. EDISON ELECTRIC INST., 2022 FINANCIAL REVIEW: ANNUAL REPORT OF THE U.S. INVESTOR-OWNED ELECTRIC UTILITY INDUSTRY 44, https://eei.org/-/media/Project/EEI/Documents/Issues-and-Policy/Finance-And-Tax/Financial_Review/FinancialReview_2022.pdf ("Specific examples of AHR investments in the electric grid include underground-ing power lines, installing cement poles, and elevating or relocating transformers… Electric companies also [investing in technologies to] better predict and prepare for extreme weather events and wildfires.").

weather events, suggestive of "utility lag,"[15] that is, a lack of responsiveness or action in the face of discernible changes in circumstances.

Indeed, ICF's Judsen Bruzgul and Neil Weisenfeld concluded in 2021 that "[t]he threats of climate change are rising, but utility responses lag behind."[16] They regarded the pace as too slow to help close what they estimate to be a $500 billion capital investment "gap" needed "to provide the level of resilience required for U.S. investor-owned energy utilities to effectively address risks from climate change and prepare energy systems for a changing environment."[17]

B. Mitigation, Adaptation, and Resilience

The Fifth National Climate Assessment offers the following key distinctions in the realm of climate change and responses to it:

> **Mitigation**: Measures to reduce the amount and rate of future climate change by reducing emissions of heat-trapping gases (primarily carbon dioxide) or removing greenhouse gases from the atmosphere.
> **Adaptation**: The process of adjusting to an actual or expected environmental change and its effects in a way that seeks to moderate harm or exploit beneficial opportunities.
> **Resilience**: The ability to prepare for threats and hazards, adapt to changing conditions, and withstand and recover rapidly from adverse conditions and disruptions.[18]

Actions toward mitigation, adaptation, and resilience are not mutually exclusive but interdependent and synergistic. All are needed to maintain safe, adequate, and reliable public utility services, and all should be addressed through mandated comprehensive planning synchronized with integrated resource, capital improvement, and operational planning. Mitigative actions at the system level aim to slow or halt global climate change[19] and make adaptation and resilience easier. Adaptive actions aim to make systems reliable and sustainable over time. Across public utility infrastructure subsectors, resilience extends conventional concepts of system reliability and endogenous capacities and vulnerabilities to account for the

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15. *See* JANICE A. BEECHER & STEVEN G. KIHM, RISK PRINCIPLES FOR PUBLIC UTILITY REGULATORS 81 (1st ed. 2016); Steve Kihm et al., *Regulatory Incentives and Disincentives for Utility In-vestments in Grid Modernization*, BERKELEY LAB 43 (2017), https://eta-publications.lbl.gov/sites/default/files/feur_8_utility_incentives_for_grid_mod_rev_062617.pdf.

16. Judsen Bruzgul & Neil Weisenfeld, *Bridging the Utility Resilience Investment Gap*, ICF (Mar. 24, 2021), https://www.icf.com/insights/energy/utility-resilience-investment-gap; *see also* Kenneth Costello, *Electric Power Resilience: The Challenges for Utilities and Regulators*, YALE J. ON REG. BULLETIN (Nov. 8, 2019), https://www.yalejreg.com/bulletin/electric-power-resilience-the-challenges-for-utilities-and-regulators/.

17. *Id.*

18. Allison R. Crimmins et al., *The Fifth National Climate Assessment,* FIFTH NAT'L CLIMATE ASSESSMENT, https://nca2023.globalchange.gov. The report identifies four stages of resilience: 1) preparing for events before they happen, 2) alleviating problems during the event, 3) recovering quickly after the event, and 4) learning from the experience to improve for next time.

19. *See* RICHARD J.T. KLEIN ET AL., *Inter-relationships Between Adaptation and Mitigation*, *in* CLIMATE CHANGE 2007: IMPACTS, ADAPTATION AND VULNERABILITY 747 (M.L. Parry et al., eds. 2007); *see also* M.L. Parry et al., *Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change,* CAMBRIDGE UNIV. PRESS at 745-77, https://www.ipcc.ch.

probability and impact of disruptions from exogenous forces. The National Renewable Energy Laboratory elaborates for electric utilities:

> A resilient power grid withstands, responds to, and recovers rapidly from major power disruptions as its designers, planners, and operators anticipate, prepare for, and adapt to changing grid conditions . . . Resilience also typically includes more extreme, rare events that go beyond 'reasonable' outages considered in resource adequacy and operational reliability.[20]

Given the limits of mitigation, the need for adaptation to climate change is apparent and urgent. Experts have recognized the need to factor climate risks into infrastructure management and planning and have distinguished between *reactive* and *proactive* adaptation: "[A]daptive measures are taken in response to climate change impacts (reactive adaptation) and in advance of impacts (proactive adaptation)."[21]

We pivot here from mitigation to focus on the urgency of climate *resilience planning* as essential to proactive public utility adaptation to the realities of climate change and its accelerating economic and social injury to people and property. Our primary audience is state regulators of investor-owned utilities, but our planning recommendations extend to all public utilities, including federal power authorities, municipal enterprises, rural cooperatives, and their respective regulators (or oversight entities) at the federal, local, and membership levels. A 2021 film satirizes denial of climate change (in the form of mass planetary extinction from an incoming comet) with the advice: "Don't Look Up!"[22] Here, we implore public utilities and their regulators to look up and take the necessary steps to protect vital public utility services against the incoming existential threat of climate change.

Part II of this article discusses some of the risks to public utilities posed by climate change as manifested in extreme weather-related events that can disrupt service, how these risks are recognized in market forces (insurance rates and coverage, bond ratings, and climate litigation), and how analytical tools can be used to assess the nature, location, and magnitude of these risks. Part III highlights some of the adaptive and preventative measures utilities could consider in a resilience plan. Part IV explains how regulators review utility failures to take affirmative adaptive measures to maintain safe, adequate, and reliable service consistent with their responsibility to investigate and penalize imprudent action or inaction. Part V addresses the broad rulemaking powers of regulatory commissions and how those existing powers can be deployed to require utilities to adopt and implement

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20. NAT'L RENEWABLE ENERGY LAB'Y, POWER SYSTEM RESILIENCE, https://www.nrel.gov/research/power-system-resilience.html#:~:text=NREL%20is%20leading%20research%20efforts,adapt%20to%20changing%20grid%20conditions.

21. James E. Neumann et al., *Climate Effects on US Infrastructure: The Economics of Adaptation for Rail, Roads, and Coastal Development*, SPRINGER LINK 43 (Aug. 19, 2021) https://doi.org/10.1007/s10584-021-03179-w.

22. Elizabeth Howell, *Climate Scientist and Netflix 'Don't Look Up' Director Talk Comet Metaphors and Global Warming,* SPACE.COM, (May 11, 2022), https://www.space.com/dont-look-up-climate-change-comet-metaphore-scientist-praise.

climate resilience plans. Part VI recommends developing resilience planning rules and considers some experience in this area. Finally, Part VII discusses how capital and operating costs to implement resilience planning can be recovered, consistent with generally accepted ratemaking principles and practices.

II. CLIMATE CHANGE AS A KNOWN AND MEASURABLE RISK

The near-unanimous scientific consensus confirms the imminent and accelerating threat of climate change.[23] Most Americans view climate change as a major threat to the country (54%) and impacting their local communities (61%).[24] The effects of climate change fall disproportionately on disadvantaged countries, communities, and households that also lack scale, resources, and capacities for mitigation, adaptation, and resilience, worsening and perpetuating environmental injustice,[25]

The impacts on critical infrastructure and operations that produce and deliver essential energy and water utility services are also coming into focus. The 2018 Fourth National Climate Assessment focuses on the potential for accelerating climate change to disrupt and damage infrastructure, reduce power generation efficiency, increase energy demand, and raise electricity costs.[26] Changing and extreme weather are also expected to impact the water cycle and, thus, the reliability and cost of drinking water, wastewater, and stormwater utility services.[27]

Even those who ignore climate science will find it hard to disregard the *market* forces that drive insurers, credit rating agencies, and financial institutions. Market actors are beginning to expect utilities to disclose and manage their climate and weather vulnerabilities and risks.[28] Insurance companies are dropping some property coverage or dramatically raising premiums in areas where climate change poses unacceptable risks.[29] A recent report from Washington State's insurance

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23. *See generally* NAT'L AERONAUTICS & SPACE ADMIN., SCIENTIFIC CONSENSUS: EARTH'S CLIMATE IS WARMING (2020) (summarizing the conclusion of 18 preeminent scientific associations (2009-2019) that anthropogenic climate change is indisputable and accelerating); *see also* Nateghi et al., *supra* note 5.

24. Alec Tyson et al., *What the Data Says About Americans' Views of Climate Change*, PEW RSCH. CTR., (Aug. 9, 2023), https://www.pewresearch.org/short-reads/2023/08/09/what-the-data-says-about-americans-views-of-climate-change.

25. Crimmins et al*., supra* note 18, at sections 4.2, 9.2, 12.2, 14.3, 15.2, 16.1, 16.2, 18.2, 19.1, 20.1, 20.3, 21.3, 22.1, 23.1, 26.4, 27.1, 31.2.

26. *See* U.S. GLOBAL CHANGE RSCH. PROGRAM, FOURTH NATIONAL CLIMATE ASSESSMENT, VOL. II 65-66, 182, 192 (2018)*; see* also JEFF GOODELL, THE HEAT WILL KILL YOU FIRST – LIFE AND DEATH ON A SCORCHED PLANET 132 (2023).

27. ENV'T PROT. AGENCY, CLIMATE IMPACTS ON WATER QUALITY, https://www.epa.gov/arc-x/climate-impacts-water-quality (Mar. 10, 2024).

28. *See generally* Rack, *supra* note 1; *see also* Yang et al., *Decomposing Climate Risks in Stock Markets* at 7 (Int'l Monetary Fund, Working Paper No. 23, 2023); MSCI, *Climate Solutions: Climate Change – A Key Risk for Institutional Investors*, https://www.msci.com/climate-solutions/, (last visited Mar. 10, 2024); *see also* Paul Munday et al., *Risky Business: Companies' Progress On Adapting To Climate Change*, S&P GLOBAL (Apr. 3, 2024), https://www.spglobal.com/_assets/documents/ratings/research/101595538.pdf.

29. Jacob Bogage, *Home Insurers Cut Natural Disasters from Policies as Climate Risks Grow*, WASH. POST (Sept. 3, 2023), https://www.washingtonpost.com/business/2023/09/03/natural-disaster-climate-insurance/; *see also* Justine McDaniel, *Citing Climate Change Risks, Farmers is Latest Insurer to Exit Florida*, WASH.

commissioner noted that during the last five years, the state's electric utilities had also seen dramatic increases in liability insurance costs, with fewer insurers willing to provide coverage and more requiring "wildfire exclusions" in policies."[30] Water utilities face parallel market challenges.[31] Reduced insurance coverage for losses or damages could increase utility financing and operating costs and rates to consumers. Notably, insurance and re-insurance providers are increasingly incentivizing investment in climate risk management.[32]

Public utilities ignore these market realities and the detrimental consequences for investors and ratepayers at their peril. Utility infrastructure can be both vulnerable and culpable in the context of climate change. Hawaii Electric Company faces several lawsuits, a downgrade in its bond ratings (increasing borrowing costs), and the prospect of bankruptcy because of the calamitous Maui wildfires.[33] Edison International's December 31, 2022, 10-K filing with the Securities and Exchange Commission discloses that despite its efforts to reduce wildfire risks, its insurance coverage may not be adequate.[34] Berkshire Hathaway told financial regulators that its performance depends partly on reducing the potential for wildfires *caused by its infrastructure* (emphasis added).[35]

POST (Jul. 12, 2023), https://www.washingtonpost.com/climate-environment/2023/07/12/farmers-insurance-leaves-florida/.

30. *New report on utilities' liability market reveals increased costs, coverage exclusions*, OFFICE OF THE INS. COMM'R: WASH. STATE (Jan. 19, 2023), https://www.insurance.wa.gov/news/new-report-utilities-liability-market-reveals-increased-costs-coverage-exclusions; *see also* Gabriel Petek, *Allocating Utility Wildfire Costs: Options and Issues for Consideration,* LEGIS. ANALYST'S OFFICE, STATE OF CALIF. (June 2019), https://lao.ca.gov/reports/2019/4079/allocating-wildfire-costs-062119.pdf.

31. *See* Erica Brown, *Water Utilities, Climate Change, Bond Ratings and Insurance: Connections and Implications*, WATER FIN. & MGMT. (Feb. 7, 2020), https://waterfm.com/water-utilities-climate-change-bond-ratings-and-insurance-connections-and-implications; *see also* ASS'N OF METRO. WATER AGENCIES, INS., BOND RATINGS AND CLIMATE RISK: A PRIMER FOR WATER UTILITIES (2019), https://www.amwa.net/assets/Insurance-BondRatings-ClimateRisk-Paper.pdf.

32. *See* Thomas Frank & E&E News, *Climate Change is Destabilizing Insurance Industry*, SCI. AM. (Mar. 23, 2023), https://www.scientificamerican.com/article/climate-change-is-destabilizing-insurance-industry/ (emphasizing climate change is "driving up prices and pushing insurers out of high risk markets"); Antonio Grimaldi et al., *Climate Change and P&C Insurance: The Threat and Opportunity*, MCKINSEY & CO. (Nov. 19, 2020), https://www.mckinsey.com/industries/financial-services/our-insights/climate-change-and-p-and-c-insurance-the-threat-and-opportunity.

33. Evan Halper, *Hawaii Utility Faces Collapse as Others Delay on Extreme Weather Risks*, WASH. POST (Aug. 25, 2023), https://www.washingtonpost.com/business/2023/08/25/hawaiian-electric-maui-fires-power-companies/.

34. Edison Int'l., Annual Report (Form 10-K) at p. 47-48 (Dec. 31, 2022) ("SEC's insurance coverage for wildfires may not be sufficient…. Climate change exacerbated weather-related incidents and other natural disasters could materially affect SCE's financial condition and results of operations.").

35. Justin Worland, *Utilities Are Becoming a Risky Business Thanks to Climate Change,* TIME (Aug. 24, 2023), https://time.com/6308144/utilities-risky-business-thanks-to-climate-change/?utm_source=Sailthru&utm_medium=email&utm_campaign=Issue:%202023-08-25%20Utility%20Dive%20Newsletter%20%5Bissue:53950%5D&utm_term=Utility%20Dive; *see also* MOODY'S INV. SERV., INC., CLIMATE CHANGE & SOVEREIGN CREDIT RISK, https://www.moodys.com/sites/products/productattachments/climate_trends_infographic_moodys.pdf (Governments also face credit risks tied to their susceptibility to climate change impacts and their own resilience measures).

A. *Planning for the Foreseeable and the Unforeseeable*

Climate-related vulnerabilities are ongoing, but extreme weather events can strike suddenly and dramatically with little forewarning. The damage caused by severe weather events, wildfires, flooding, and drought to energy and water infrastructure and operations is increasingly apparent and highlights the water-energy nexus.[36] Indeed, freshwater withdrawals for thermoelectric cooling far outweigh those for public supply.[37] Flash flooding from hurricanes is no longer confined to coastal areas, even extending to desert environments.[38] Secondary risks of weather events are also coming into view, some of which could undermine mitigation measures. For example, the particulate matter falling on solar panels during fires substantially reduces their output, a factor that at least one utility is now incorporating into its planning.[39]

Today's climate experience may be prologue, but the past is not always predictive. Not long ago, the prospect of "a killer heat wave in the Pacific Northwest," causing uncontrollable wildfires in Washington, Oregon, and British Columbia in 2021 "seemed as likely as snow in the Sahara."[40]

While historical records may be of limited value, data-intensive and spatial climate and weather modeling has matured. Climate change data for modeling and planning is also increasingly granular.[41] Modern meteorology makes it possible to forecast weather events that could threaten utility operations or damage infrastructure. Among other resources, the National Association of Insurance Commissioners (NAIC) Climate Risk and Resource Center provides early warning systems, predictive modeling tools, and pre-disaster mitigation strategies.[42] Several organizations, including Resources for the Future, offer additional resources and tools.[43]

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36. U.S. DEP'T OF ENERGY, THE WATER-ENERGY NEXUS: CHALLENGES AND OPPORTUNITIES OVERVIEW AND SUMMARY (2014), https://www.energy.gov/sites/default/files/2014/07/f17/Water%20Energy%20Nexus%20Executive%20Summary%20July%202014.pdf.

37. U.S. GEOLOGICAL SURV., ESTIMATED USE OF WATER IN THE UNITED STATES (2015). https://doi.org/10.3133/cir1441.

38. *See, e.g.*, NAT'L PARK SERV., HURRICANE HILARY IN DEATH VALLEY NATIONAL PARK, (Aug. 23, 2023), https://www.nps.gov/deva/learn/nature/hilary.htm#:~:text=This%20included%20heavy%20rain%2C%20which,of%201.7in%20(43mm) (Hilary dumped 2.2 inches on Furnace Creek in Death Valley "making it the all time wettest day recorded at that location," causing extensive wreckage in that desert environment hundreds of miles from the Pacific Ocean); Sarah Kaplan, *Tennessee floods show a pressing climate danger across America: 'Walls of Water,'* WASH. POST (Aug. 23, 2021), https://www.washingtonpost.com/climate- environment/2021/08/23/tennessee-floods-show-pressing-climate-danger-across-america-wall-water ("Tennessee's flash floods underscore the peril climate change poses even in inland areas.").

39. Telephone Interview with Steven Lins and Andrew Meditz, Sacramento Municipal Utility District (Aug. 31, 2023).

40. Goodell, *supra* note 26, at 18-19.

41. Juliet S. Homer et al., *Emerging Best Practices for Electric Utility Planning With Climate Variability: A Resource for Utilities and Regulators*, PAC. NW. NAT'L LAB'Y 34 (2023).

42. *See Climate Risk and Resiliency Resource Center*, NAIC, https://content.naic.org/climate-resiliency-resource.htm (last visited Mar. 21, 2024).

43. *See Data Tools,* RES. FOR THE FUTURE, https://www.rff.org/publications/data-tools/.

An initiative by the Electric Power Research Institute (EPRI) provides "decision-relevant" resources on climate change and weather variability to the energy sector to guide cost-effective investments in energy grid reliability and resilience.[44] Similarly, the American Water Works Association and the Water Research Foundation provide their respective professional and utility members with management resources for climate and weather adaptation resources, including flood mitigation planning.[45] Several other organizations have banded together to develop a resilience assessment framework for the sector.[46] The U.S. EPA also offers various tools to build water utility resilience.[47] As climate science evolves, policymakers, regulators, and utility managers will have better data and more robust tools to enhance planning and decision-making,

III. Resilience Measures in the Face of Accelerating Climate Change and Extreme Weather Threats

In 2021, the electricity sector contributed 25% of total U.S. greenhouse gas emissions by burning fossil fuels, second to the transportation sector (28.5%).[48] Public utilities are continually building and replacing infrastructure. Underscoring the intertwined nature of mitigation and resilience planning, if these capital investments *add* to the emissions that trap heat and cause climate change, adaptation and resilience become ever more challenging, expensive, and potentially ineffective. Without simultaneous mitigation of greenhouse gas emissions, resilience becomes a treadmill going nowhere, which makes comprehensive governmental and regulatory policy particularly essential. Even utilities taking measures to reach zero carbon emissions will still need to devote effort toward adaptation and resilience to manage their risks and the direct and indirect costs of climate change.

As previously noted, resilience in the utility sector extends long-prevailing reliability standards. As Andrew Ott of the PJM Interconnection observed, the concepts have commonalities but with relevant distinctions:

> Reliability is about designing, running, and maintaining electricity supply to provide an adequate, safe, and stable flow of electricity . . . Equipment failure and extreme weather are common threats to reliability . . . Resilience is

44. The authors thank Alex Pozdnyakov of the Long Island Power Authority, who pointed us to industry research in this area. *See* ELEC. POWER RSCH. INST., CLIMATE READI: RESILIENCE AND ADAPTATION INITIATIVE: PREPARING FOR THE FUTURE AHEAD (Apr. 2022), https://publicdownload.epri.com/PublicAttachmentDownload.svc/AttachmentId=77841.

45. ERIC HERSH ET AL., HOLISTIC APPROACHES TO FLOOD MITIGATION PLANNING AND MODELING UNDER EXTREME EVENTS AND CLIMATE IMPACTS, THE WATER RSCH. FOUND. (2023).

46. Paul Fleming et al., *Water Resilience Assessment Framework: Guidance for Water Utilities* (2024), https://ceowatermandate.org/files/Water-Resilience-Assessment-Framework-Guidance-for-Water-Utilities.pdf?utm_medium=email&utm_source=govdelivery.

47. The utility concerns about the limited availability of data and the costs of analyzing the data cited in the 2020 Sabin Center/EDF study ignore the fact that the cost of assembling and analyzing the data does not have to be borne by individual utilities. NOAA, EPRI, EPA and DOE laboratories do much of this type of research. *Creating Resilient Water Utilities*, EPA (Dec. 22, 2016), https://19january2017snapshot.epa.gov/crwu_.html.

48. ENV'T PROT. AGENCY, INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990-2021, ES-22 (2023), https://www.epa.gov/system/files/documents/2023-04/US-GHG-Inventory-2023-Main-Text.pdf.

> directly linked to the concept of reliability; you cannot be resilient if you are not first reliable. Resilience encompasses additional concepts – preparing for, operating through, and recovering from significant disruptions, no matter what the cause. It is about our ability to withstand extreme or prolonged events.[49]

Resilience is relative; it is the ability to maintain or "bounce back" to a previous state that itself is likely affected by *non-stationary* long-term trends in weather conditions.[50] Climate resilience calls for building knowledge and capacities to plan for, adapt to, and recover from extreme weather-related and other events.[51]

Examples of weather-related risks from climate change and related adaptive measures and operating practices are summarized in Table 1. Risks and their scope and magnitudes vary geographically, but no system can claim immunity from the potential impacts.

Table 1. Examples of Weather-Related Risks to Utilities from Climate Change and Adaptive Measures[52]

Weather-related Risks	Adaptive Measures and Operating Practices
Rising sea levels	Shoreline vegetation management, facility relocation, sea wall construction
Coastal storm surges	Vegetation management, public safety power shut-off (PSPS), elevation of critical assets, facility relocation
Flooding	Diversion, elevation of critical assets, nature-based stormwater management
Drought	Technical efficiency, recirculating cooling systems, raw water storage
Extreme heat	PSPS, derate some transformers and conductors
Extreme cold	Weatherization of fuel-delivery systems and production facilities
Extreme wind	Vegetation management, PSPS, wire undergrounding

49. Andy Ott, *Reliability and Resilience: Different Concepts, Common Goals*, PJM INSIDE LINES (Dec. 17, 2018), https://insidelines.pjm.com/reliability-and-resilience-different-concepts-common-goals/; *see also* T.J. Galloway Sr., *Advancing Reliability and Resilience of the Grid*, N. AM. TRANSMISSION F. (July 31, 2018) https://www.ferc.gov/sites/default/files/2020-08/Galloway-North-American-Transmission-Forum.pdf.

50. CTR. FOR CLIMATE AND ENERGY SOL., WHAT IS CLIMATE RESILIENCE AND WHY DOES IT MATTER? (Apr. 2019), https://www.c2es.org/document/what-is-climate-resilience-and-why-does-it-matter/.

51. *Id.*

52. *See* SEATTLE CITY LIGHT, SEATTLE CITY LIGHT CLIMATE CHANGE VULNERABILITY ASSESSMENT AND ADAPTATION PLAN, 2, https://www.seattle.gov/documents/Departments/CityLight/ClimateChangeAdaptationPlan.pdf [hereinafter Seattle Action Plan].

Wildfires	Vegetation management, PPSPS, protective wire coating, wire undergrounding

In addition to adaptive operating practices (such as vegetation management), emerging technologies can enhance reliability and resilience.[53] These include optimized distributed resources aggregated into virtual power plants and their strategic interconnection;[54] energy and water storage from utility to consumer scales; microgrids[55] and combined heat and power (typically, cogeneration) systems;[56] real-time satellite and video (drone) surveillance; remote sensing and monitoring and dynamic line ratings; alternative materials (such as metal utility poles);[57] power-flow control (energy) and pressure management (water); advanced metering infrastructure; coordinated resource management (including colocation and multi-utility tunnels); and nature-based solutions for urban flood management (such as wetlands and stormwater parks).[58]

The combination of microgrids with distributed resources and battery storage to maintain electricity reliability at medical, research, and other critical facilities is frequently identified.[59, 60] Microgrids can localize ("island") the impacts of

53. Allyson Chiu, *How sensors could help catch wildfires before they spread*, WASH. POST (June 16, 2023), https://www.washingtonpost.com/climate-solutions/2023/06/15/wildfire-early-detection-sensors-technology/.

54. *See* Patrick Cooley, *US virtual power plants expected to proliferate as reliability needs rise with increasing renewables*, UTIL. DIVE (Aug. 14, 2023), https://www.utilitydive.com/news/virtual-power-plants-proliferate-reliability-needs-renewable-energy/690322/ (explaining how utilities are embracing virtual power plants to provide resilience against weather-related outages).

55. U.S. DEP'T OF ENERGY, MICROGRIDS OVERVIEW (Feb. 2021), https://www.energy.gov/eere/amo/articles/combined-heat-and-power-technology-fact-sheet-series-microgrids#:~:text=A%20microgrid%20is%20a%20group,grid%2Dconnected%20or%20island%20mode ("A microgrid is a group of interconnected loads and distributed energy resources that act as a single controllable entity" that "can connect and disconnect from the {electrical] grid and operate in grid-connected or island mode," and thereby "improve customer reliability and resilience to grid disturbances."); *see also* Akhtar Hussain et al., *Microgrids as a resilience resource and strategies used by microgrids for enhancing resilience*, 240 APPLIED ENERGY 56, 72 (2019).

56. *See, e.g.,* BETTER BUILDINGS – U.S. DEP'T OF ENERGY, COMBINED HEAT AND POWER FOR RESILIENCY – COMPLETED, https://betterbuildingssolutioncenter.energy.gov/accelerators/combined-heat-and-power-resiliency (last visited Mar. 21, 2024) (discussing the "Combined Heat and Power for Resiliency Accelerator"); *see also* BETTER BUILDINGS – U.S. DEP'T OF ENERGY, THE DG FOR RESILIENCE PLANNING GUIDE, https://dg.resilienceguide.ornl.gov/ (last visited Mar. 21, 2024); BETTER BUILDINGS – U.S. DEP'T OF ENERGY, APPLYING CHP IN CI 101, https://dg.resilienceguide.ornl.gov/applying-chp (last visited Mar. 21, 2024) (describing how CHP can aid climate resiliency for universities, data centers, fire stations, supermarkets, government facilities, hospitals, military bases, police stations, schools, prisons, and water treatment plants).

57. *See* NAT'L INTEGRATED DRAUGHT INFO. SYS., DROUGHT STATUS UPDATE FOR THE PACIFIC NORTHWEST (July 29, 2021), htpps://www.drought.gov/drought-status-update-pacific-northwest (Pacific Northwest "has not seen this dry of a spring since 1924"); Andrea Thompson, *What Caused Maui's Devastating Wildfires?*, SCI. AM. (Aug. 9, 2023), htpps://scientificamerican.com/what-caused-mauis-apocalytic-wildfires/.

58. *Stormwater Parks,* FED. ENERGY MGMT. AGENCY (Oct. 27, 2021), https://www.fema.gov/node/stormwater-parks. ("Stormwater parks are recreational spaces that are designed to flood during extreme events and to withstand flooding.")

59. *See* Hussain, *supra* note 55 (microgrids used to adapt to climate change).

60. Hyleah O'Quinn, *Energy Resilience Reference Guide Chapter Three: Climate Resilience Strategies for regulators*, NARUC 26 (Sept. 2023), https://pubs.naruc.org/pub/45930E31-AD27-1228-C5A0-

weather events that interrupt service, separating infrastructure and facilitating faster service restoration. The advantages of microgrids include modular design, flexibility, scalability, islanding, deployment in remote areas, and rapid emergency response and disaster recovery.[61] Given their pronounced vulnerabilities, some island states are leading the way on microgrids.[62] In 2018, Hawaii's legislature directed its state commission "to establish a microgrids services tariff to encourage and facilitate the development and use of energy resilient microgrids."[63]

In various forms and scales, batteries support resilience by storing electrical energy. Pumped storage facilities use water reservoirs and gravity to feed hydropower systems for later use; compressed air and chillers can also be used. Batteries can also convert chemical energy into electrical energy using an electrochemical oxidation-reduction ("redox") reaction. Batteries can store energy produced from intermittent renewable resources that displace fossil fuels, or energy generated off-peak that might otherwise be lost. In combination, microgrids and storage enhance resilience in facilities requiring an uninterrupted power supply, such as hospitals, critical care facilities, and biomedical and other scientific research laboratories.

Demand-side solutions can also serve resilience, including technologies such as direct-load controls and pricing methods for shifting or reducing usage, generally and under certain conditions. DOE has highlighted the role of demand response and load management combined with distributed resources in limiting and overcoming power outages.[64]

In addition to technological infrastructure solutions, utilities can explore managerial options to improve resilience and save costs. Collaboration among utilities might include insurance pools, joint purchasing and contracting, shared equipment and supplies, and mutual aid agreements. Alternative strategies should be subject to an evaluation of relative feasibility, efficiency, and effectiveness. Undergrounding of power lines, for example, can shield utility infrastructure from high winds and wildfires but not necessarily from flooding, and alternative technological solutions, such as remote heat sensors for early fire detection and shutoff systems, may be more cost-effective.[65] As mentioned below, comparing a full array of options enables prudence review for cost recovery.

3FFCFD9DAD95?_gl=1*oi6us1*_ga*MTc5NTg4MjEzNi4xNzEwMTA2NDcz*_ga_QLH1N3Q1NF*MTcxMDEwNjQ3My4xLjAuMTcxMDEwNjQ3My4wLjAuMA (citing H.B. No. 2110).

61. *Id.* at 25.

62. Laurie Stone, *How the Storm-Ravaged Bahamas Can Be a Model for Resilient Energy*, ROCKY MOUNTAIN INST. (July 26, 2022), https://rmi.org/how-the-storm-ravaged-bahamas-can-be-a-model-for-resilient-energy/.

63. Kelsey Jones et al., *State Microgrid Policy, Programmatic and Regulatory Framework,* NAT'L ASS'N OF REGUL. UTIL. COMM'RS 31 (2023), https://pubs.naruc.org/pub/2649E6EB-D7CE-77DC-2BE3-89D48A713213.

64. U.S. DEP'T OF ENERGY, ENERGY EFFICIENCY AND DISTRIBUTED GENERATION FOR RESILIENCE: WITHSTANDING GRID OUTAGES FOR LESS 2 (July 2019), https://www.energy.gov/scep/slsc/articles/energy-efficiency-and-distributed-generation-resilience-withstanding-grid.

65. Chiu, *supra* note 53 (noting that one Rockville, MD company manufacturing fire sensors "is working with four utilities around the country, as well as stakeholders in eight states and has two engagements in Canada."). There may also be less expensive alternatives to sea walls*; see* Geoff Dembicki, *The Progressive Way to*

IV. CLIMATE RESILIENCE PLANNING AS A MATTER OF PRUDENCE

The reluctance of some public utility regulators to address environmental challenges, including the impact of climate change on service continuity, might be due to their perception (or misperception) of the boundaries of their responsibilities to serve the public interest. Regulatory agencies sometimes struggle with aligning the objectives of reliability, affordability, and environmentally sound practices. Some might be concerned about the impact on rates of capital and operating costs needed to address climate resilience.

Others might hold that environmental protection and climate response are not within their charge or expertise and are better left to other policymakers, environmental regulators, or legislators. Under this view, utility regulators are mainly relegated to assessing costs and prudence in implementing technological standards, mandates, and restrictions set by environmental and other regulators and setting rates for compliance and recovery of any legislatively determined costs, including carbon prices or taxes. Still, other public utility commissions might also feel ill-equipped or disinclined to modify standards, practices, and processes to meet the climate change challenge.[66]

A. Resilience Planning and Service Obligations

These concerns do not excuse negligence in the face of known climate risks to the provision of utility services. The objectives and obligations of safe, adequate, reliable, and economical service are at the heart of public utility management and regulation.[67] Regulators are responsible for ensuring that utility infrastructure is maintained and operated appropriately and for investigating failures that adversely affect the quality and cost of service. No new authorizing legislation is needed before regulators can act to ensure resilience; it is part and parcel of the universal charge of the commissions to ensure service reliability at a reasonable cost to consumers.

Whether utilities meet their obligation to provide safe, adequate, and reliable service in the most cost-efficient and effective manner falls squarely within the prudence standard by which utility investments and operating expenditures are deemed appropriate for cost recovery. Prudence requires ongoing attention to dynamic circumstances. Today's public utilities and their regulators have an expanding set of analytical and planning tools they can and should apply to ensure prudent management of contemporary systems, including resilience planning (e.g., modeling and forecasting, multi-objective frameworks, and increasingly, machine learning and artificial intelligence).[68]

Save Cities From Superstorms, THE NEW REPUBLIC (Aug. 2, 2023), https://newrepublic.com/article/174664/progressive-way-save-cities-superstorms (discussing natural solutions to sea level rise that can be implemented "quickly and often at lower costs than traditional gray infrastructure" such as sea walls).

66. Inara Scott, *Teaching an Old Dog New Tricks: Adapting Public Utility Commissioners to Meet Twenty-First Century Climate Challenges*, 32 HARV. ENV'T L. REV. 371, 375-76 (2014).

67. *See, e.g.*, Webb et al., *supra* note 7, at 8.

68. Beecher, *supra* note 15.

The prudence standard is core to the obligation to ensure that licensed utility franchises serve the "public convenience and necessity" and that the terms and conditions of service, including whether investor returns and customer rates are "just and reasonable."[69] Prudence is generally understood as "what is considered 'reasonable' under the circumstances."[70] Prudent performance is expected and does not warrant special incentives; extraordinary financial incentives and rewards for prudence constitute a windfall to the utility.[71]

Traditional prudence assessment often focuses on unnecessary or extravagant spending. But regulators can also determine whether the utility has adequately addressed "reliability, innovation, safety, and environmental effects."[72] In their capacity to substitute for market forces, regulators can penalize imprudence through disallowances or adjustments to returns to promote desirable utility performance.[73]

A common conception is that a utility satisfies the prudence standard where it acts in conformance with "fair and prevailing utility practice."[74] The purpose of this approach is to reprimand a utility for deviating from industry norms to the detriment of consumers. Conformance to prevailing industry practice, however, is not conclusive evidence of a utility's prudence. An industrywide failure to address known and knowable risks should not insulate a public utility from regulatory prudence reviews. A Massachusetts case is illustrative. Invoking new enforcement powers conferred by the legislature in 2009, regulators imposed million-dollar fines on several utilities for sluggish service restoration in the aftermath of tropical storm Irene in 2011 and a subsequent snowstorm.[75] The state's Supreme Court upheld the fines, rejecting the utilities' argument that their conduct should have been measured not against the 2009 statute's "reasonableness" standard but against the more forgiving standard based on prevailing utility practices.[76]

Critically, imprudence by utility managers can be reflected in action but also in the *failure to act.* An act of omission can be "just as imprudent as an act of commission,"[77] although not necessarily so. As the Pennsylvania Public Utility

69. SCOTT HEMPLING, REGULATING PUBLIC UTILITY PERFORMANCE: THE LAW OF MARKET STRUCTURE, PRICING AND JURISDICTION 252 (2021).

70. Rev. of N. Ind. Pub. Serv. Co. LLC's R.M. Schahfer Generating Station Fire & Related Impact on Fuel Procurement and Fuel Costs, No. 38706 FAC 130 S1 45 (2022).

71. *See* California Pub. Util. Comm'n v. FERC, 879 F.3d 966, 977 (9th Cir. 2018)*; see also* Supplemental Notice of Proposed Rule Making, *Electric Transmission Incentives Policy Under Section 219 of the Federal Power Act*, 175 FERC ¶ 61,035 (2021) (concurring opinion of Commissioner Christie).

72. Hempling, *supra* note 69, at 257.

73. *Id.* at 235*; see also* Entergy Gulf States, Inc. v. Louisiana Pub. Serv. Comm'n, 726 So. 2d 870, 874 (La. 1999).

74. Boston Gas Co. v. Dept. of Pub. Utils., 359 Mass. 292, 301 (1971).

75. Massachusetts Elect. Co. v. Dept. of Pub. Utils., 469 Mass. 553 (2014).

76. *Id.* at 554-55.

77. Penn. Pub. Util. Comm'n v. Philadelphia Elec. Co. (Part 1 of 6), R-891364; R-891364, C001-C007, 1990 Pa. PUC LEXIS 155, *64-65 [hereinafter *PPUC*]; *see also* Georgia Power Co. v. Georgia Pub. Serv. Comm'n, 396 S.E.2d 562, 569 (1990).

Commission has found, reasonable alternatives must have been available.[78] History abounds with examples of utility failures to act when better options were available, including the following findings of imprudence:

- Gulf Power failed to terminate a high-price coal contract when lower-priced coal was readily available (1984).[79]
- Kansas Gas and Electric failed to discover an operational problem that extended a scheduled maintenance outage of its nuclear plant, forcing it to buy more expensive replacement power (1990).[80]
- Gulf States Utilities failed to fulfill its commitment to the Nuclear Regulatory Commission to install a bypass switch, causing it to purchase expensive replacement power to prevent a forced plant shutdown (1993).[81]
- Entergy Gulf States failed to avoid an outage of its power plant and the need to purchase expensive replacement power if it had installed a bypass switch the company had committed to the NRC to install years earlier (1999).[82]
- San Diego Gas & Electric failed to anticipate wind impacts on its facilities based on earlier wildfire experience and was denied recovery of restoration costs of $400 million (2017).[83]
- Xcel Energy failed to dispatch "peak-shaving" resources to reduce the amount of costly gas it had to buy during a severe cold snap (2022).[84]
- Public Service Co. of Colorado failed to urge customers to conserve energy during Storm Uri, forcing it to buy relatively more expensive replacement power (2022).[85]

Any past rationale for inaction by some utilities that climate resilience planning is "an exercise in conjecture"[86] (as recounted in the 2020 Sabin-EDF study) is no longer credible. Resilience planning for climate change is a matter of prudence because climate change risks are *known and actionable*. Resilience requires

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78. PPUC, *supra* note 77, at *65.

79. In re: Investigation of Fuel Cost Recovery Clauses of Electric Utilities (Gulf Power Co. – Maxine Mine), 84 FPSC 6:295 (June 22, 1984).

80. Kansas Gas and Elec. Co. v. State Corp. Comm'n of State of Kan., 794 P.2d 1165, 1174 (Kan. Ct. App. 1990).

81. Re Gulf States Utilities Co., 19 Tex. P.U.C. Bull. 1401 (Aug. 19, 1993).

82. Entergy Gulf States, Inc. v. Louisiana Pub. Serv. Comm'n, 726 So. 2d 870, 886 (La. 1999).

83. Application of the San Diego Gas & Electric Company (U902E) for Authorization to Recover Costs Related to the 2007 Southern California Wildfires Recorded in the Wildfire Expense Memorandum Account (WEMA) 7 (Cal. P.U.C. 2015).

84. In the Matter of the Petition of Xcel N. States Power Co. d/b/a Xcel Energy to Recover Feb. 2021 Nat. Gas Costs in the Matter of a Comm'n Investigation into the Impact of Severe Weather in Feb. 2021 on Impacted Minnesota Nat. Gas Utilities & Customers, No. G-002/CI-21-610, 2022 WL 13983153 (Oct. 19, 2022).

85. In Re the Application of Public Service Co. of Colorado, for Recovery of Costs Associated with the Feb. 2021 Extreme Weather Event for its Electric and Gas Utilities, 2022 Co. PUC Decision C22-0413 (Co. P.U.C. June 22, 2022), available at www.dora.state.co.us.

86. Webb et al., *supra* note 7, at 10.

knowledge, foresight, planning, and decision-making by utilities, subject to regulatory standards of review. State and local rate regulators can and should monitor the prudence of climate resilience spending during and between rate cases. They also have the responsibility and authority to ensure prudence through comprehensive planning and operational changes responsive to evolving hazards and threats (from natural and human origins), allowing for appropriate cost recovery while remaining vigilant in policing and penalizing imprudence as necessary.

B. Resilience Planning Compliance and Litigation over Damages

The Sabin-EDF study found that public utility resistance to resilience planning grew out of concerns that they would be compelled to make substantial investments yet still be exposed to civil or even criminal liability for the damages of service interruptions. That concern seems misplaced. An approved and implemented resilience plan should help protect the utility from civil or criminal exposure. Civil or criminal liability apportions culpability for "prior impacts" and past failures to prepare for climate change.[87] Central to all successful litigation or prosecutions is recognizing that the defendant, here the public utility, has violated a duty or standard of care (civil) or a criminal statute. Preparing, implementing, and complying with an approved resilience plan potentially provides an affirmative defense to any civil or criminal complaint growing out of a service interruption tied to climate-related weather events.[88]

Plaintiff-favorable decisions on climate resilience claims, although redressing prior harms, can inform resilience planning. Adverse decisions can identify planning gaps, incentivize utilities to improve their resilience plans, and prompt regulators to revise their climate resilience planning requirements.

V. RULEMAKING AUTHORITY TO MANDATE AND ENFORCE UTILITY RESILIENCE PLANNING

A. Responsibility and Authority to Ensure Safe, Adequate, and Reliable Service

The review of utility prudence is essentially reactive and primarily used to penalize past conduct or inaction found to be imprudent. This practice is not to say that regulatory oversight is only reactive and that prudence reviews come into play only after disaster strikes. With a finding of imprudence, regulators can order corrective action by utilities to avoid or mitigate adverse consequences for infra-

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87. *Id.* at 27.

88. *Cf.* Richard C. Ausness, *The Case for a "Strong" Regulatory Compliance Defense*, 55 MD. L. REV. 1210, 1239 (2008), favoring a compliance defense under multiple regulatory regimes. At least one court has concluded that private common law nuisance claims over damage to the climate are preempted by the Clean Air Act and EPA regulations implementing that Act. City of New York v. Chevron Corp, 993 F.3d 81, 95-96 (2d Cir. 2021). While that case dealt with climate mitigation measures, an enforceable, ongoing state-approved resilience planning mandate might similarly foreclose a private cause of action; *see, e.g.*, San Diego Gas & Electric Co. v. Superior Court, 13 Cal. 4th 893, 916-19 (1996) (upholding decision denying lawsuit for service interruption damages where tariff under regulator's "continuing supervisory or regulatory program" precluded such private claims).

structure, services, or ratepayers. The typical regulatory enabling statute also authorizes agencies to clarify performance expectations proactively through rulemaking, which can frame subsequent prudence evaluation, including in the context of performance-based regulation.

State regulators, like their federal counterparts, are given broad mandates to ensure the safety, adequacy, and reliability of utility services, even as circumstances change (predictably or unpredictably). State commission authority and rulemaking powers readily extend to requiring, specifying, and enforcing climate resilience planning.[89] States typically also provide for broad participation and public comment in the rulemaking process.[90] A closely related precedent for resilience rulemaking can be found in the integrated resource plans (IRPs) that many states require (for energy),[91] as well as asset management or capital improvement plans (for water).[92] Examples might also be found in rulemaking for reliability, outage management and restoration, grid modernization, and physical and cyber security.

Rules for IRPs demonstrate how state commissions have used their existing authority to address changing industry circumstances. IRPs were initiated in response to fuel price volatility, concerns about supply-side capacity, and growing interest in demand-side solutions."[93] In many jurisdictions, regulators adopted IRP rules in response to specific legislation,[94] but integrated planning requirements have also been prescribed pursuant to the general authority and obligations

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89 . We reviewed the rulemaking powers in six diverse states: California, Kansas, Minnesota, Pennsylvania, Texas, and Washington state. The public utility regulator in each of these states is empowered with the ability to take all actions necessary, proper, or convenient to ensure the adequate, safe, and reliable provision of public utility service. *See, e.g*., Cal. Pub. Util. Code § 701; Kan. Stat. Ann. §§ 66-101, 1108(b), 1188, 1201, 1216; Minn. Stat. § 216B.08; 2 Pa. C.S. § 102(a); Tex. Util. Code Ann. §§ 14.001, 14.002; Wash. Rev. Code § 80.01.040 (3)-(4).

90. *See* CAL. PUB. UTILS. COMM'N, PROVIDING PUBLIC COMMENT AT THE CPUC: FOUR WAYS TO PROVIDE COMMENTS TO THE CPUC, https://www.cpuc.ca.gov/about-cpuc/divisions/news-and-public-information-office/public-advisors-office/providing-public-comments-at-the-cpuc#:~:text=Parties%20to%20a%20proceeding%20must,public%20on%20the%20CPUC%E2%80%99s%20website (last visited Mar. 8, 2024); KAN. CORP. COMM'N, PUBLIC COMMENTS FREQUENTLY ASKED QUESTIONS, https://www.kcc.ks.gov/public-comments-frequently-asked-questions (last visited Mar. 8, 2024); MINN. PUB. UTILS. COMM'N, GUIDE FOR PUBLIC PARTICIPATION AND PUBLIC COMMENT 1 (2012) https://mn.gov/puc-stat/documents//pdf_files/013992.pdf; PA. INDEP. REG. REV. COMM'N, FILING A COMMENT, https://www.irrc.state.pa.us/contact/comments.cfm (last visited Mar. 8, 2024); TEX. PUB. UTIL. COMM'N, MAKING RULES AT THE PUC, https://ftp.puc.texas.gov/public/puct-info/industry/projects/administrative/PUCTX-RulemakingProcess-fin.pdf (last visited Mar. 8, 2024); WASH. STATE OFF. OF THE ATT'Y GEN., PUBLIC INPUT, https://www.atg.wa.gov/public-input (last visited Mar. 8, 2024).

91. Rachel Wilson & Bruce Biewald, *Best Practices in Electric Utility Integrated Resource Planning*, REGUL. ASSISTANCE PROJECT 6 (June 2013), https://www.raponline.org/wp-content/uploads/2023/09/rapsynapse-wilsonbiewald-bestpracticesinirp-2013-jun-21.pdf.

92. *Id.* at 2, 6.

93. MIDWEST ENERGY EFFICIENCY ALL., INTEGRATED RESOURCE PLANS CRITERIA FOR AN EFFECTIVE PLANNING TOOL 1, https://www.energy.gov/scep/slsc/articles/integrated-resource-plans-criteria-effective-planning-tool (last visited Mar. 8, 2024); *see also* Wilson & Biewald, *supra* note 91, at 2.

94. Wilson & Biewald, *supra* note 91, at 34-36; *see also* N.C. UTIL. COMM'N, R8-60 INTEGRATED RESOURCE PLANNING AND FILINGS, http://ncrules.state.nc.us/ncac/title%2004%20-%20commerce/chap-

of commissions to ensure the provision of safe, adequate, reliable, and economical service.[95]

Resource and resilience planning both aim to ensure that utilities will be able to meet their customers' current and future needs. IRPs focus on environmental impacts and bringing diversity and balance to the consideration of supply and demand-side resource capacities; IRP tools have evolved to encompass renewable portfolio standards and demand response programs. The complementary role of resilience plans is to ensure that utility infrastructure and operating procedures can withstand or recover from foreseeable events associated with climate change. A comprehensive planning framework can ensure that resilience plans are incorporated into the long-term resource adequacy and capital improvement plans that many regulated utilities must file with regulators and keep current.[96]

While the risks to service continuity posed by climate change and other contemporary threats, such as cyber-attacks, were unknown when the state public utility statutes were initially enacted, executives and legislatures have long been concerned about *adapting regulation* in an evolving context. That is why regulatory statutes are written in broad terms. As the Supreme Court has explained with regard to federal regulatory mandates:

> Regulatory agencies do not establish rules of conduct to last forever; they are supposed, within the limits of the law and of fair and prudent administration, to adapt their rules and practices to the Nation's needs in a volatile, changing economy. They are neither required nor supposed to regulate the present and the future within the inflexible limits of yesterday.[97]

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ter%2011%20-%20utilities%20commission/04%20ncac%2011%20r08-60.pdf, (last visited Mar. 8, 2024) (implement North Carolina G.S. 62-2(a) 3 and (3a), which grant the state's utility commission authority to "promote adequate, reliable and economical utility service to all of the citizens and residents of the State" and to ensure that utilities plan using a mix of demand-side, energy efficiency and generation sources); *see also* N.C. UTIL. COMM'N, § 62-2. DECLARATION OF POLICY., 1, https://www.ncleg.gov/EnactedLegislation/Statutes/PDF/BySection/Chapter_62/GS_62-2.pdf. (last visited Mar. 8, 2024).

95. *See, e.g.*, 4 C.S.R. § 240-22.010 (Mo. 2011) (authorized by RSMo §§386.040, empowering the state commission with "all powers necessary or proper to enable it carry out fully and effectively all the purposes of this Chapter" and 386.610) (protecting the public welfare and "efficient facilities and substantial justice between patrons and public utilities").; Order No. 07-002, *Investigation Into Integrated Resource Planning*, PUB. UTIL. COMM'N OF OR., 1 (2007), https://apps.puc.state.or.us/orders/2007ords/07-002.pdf (first adopted in 1989, Order No. 89-507, Order No. 89-507 - Oregon Public Utility Commission, relied on ORS 756.515) (empowering state commission to investigate on its own motion whether any current utility service is "unsafe or inadequate" and to effectuate the same orders it could issue on a third-party complaint).

96. For comprehensive recommendations on how public utilities can most effectively structure and manage their climate-change resilience plans, *see* Craig D. Zamuda et al., *Resilience management practices for electric utilities and extreme weather*, 32 ELEC. J. 1 (2019), https://toolkit.climate.gov/sites/default/files/Resilience%20management%20practices%20for%20electric%20utilities%20and%20extrreme%20weat....pdf.

97. American Trucking Ass'ns v. Atchison, Topeka, & Santa Fe Ry. Co., 387 U.S. 397, 416 (1967).

B. Developing a Resilience Planning Rule

Despite progress toward climate resilience planning by utilities, there remains a need for a definitive and proactive process to frame regulatory requirements and clarify expectations.[98] As a start, a rulemaking process for resilience planning should:

- Detail the purpose of resilience planning to identify known, foreseeable, and emerging climate change vulnerabilities and risks.
- Be transparent, fair, and inclusive, readily accessible to stakeholders and the public affected by climate change and its costs, including the cost of resilience.
- Be efficient in ensuring timely preparation of resilience plans and implementation of adaptative strategies.
- Clarify procedures and expectations about implementation timelines and cost recovery of expenditures to implement an approved plan.

Resilience planning should commit utilities to making investments, managing assets, and implementing operating protocols that effect prudent and meaningful climate resilience consistent with approved plans. Regulators can advance the utility planning process by establishing rules and directives that, among other things:

- Specify the objectives and scope of resilience plans and the processes for their development, approval, implementation, enforcement, and evolution.[99]
- Address how utilities will identify and manage vulnerabilities specific to the services they provide, the locations in which they operate, and the populations they serve, including disadvantaged communities and households.[100]
- Ensure transparency and disclosure in plans about risks and risk management to all stakeholders.
- Include requirements for considering alternative strategies and designs and their costs and relative cost-effectiveness.

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98. Judsen Bruzgul & Neil Weisenfeld, *Resilient Power: How Utilities Can Identify and Effectively Prepare for Increasing Climate Risks,* ICF CLIMATE CTR. (2021), https://www.icf.com/insights/energy/resilient-power-utilities-prepare-climate-risks.

99. For guidance across key planning steps, *see* U.S. DEP'T OF ENERGY, CLIMATE CHANGE AND THE ELEC. SECTOR: GUIDE FOR CLIMATE CHANGE RESILIENCE PLANNING (Sept. 2016), https://toolkit.climate.gov/sites/default/files/Climate%20Change%20and%20the%20Electricity%20Sector%20Guide%20for%20Climate%20Change%20Resilience%20Planning%20September%202016_0.pdf.

100. At the federal level, for example, the Federal Energy Regulatory Commission (FERC) has adopted a rule requiring public utility electric transmission providers to file one-time informational reports on extreme weather vulnerability assessments. *See* FERC, PRESENTATION | E-1: TRANSMISSION SYS. PLANNING PERFORMANCE REQUIREMENTS FOR EXTREME WEATHER; E-2: ONE-TIME REP. ON EXTREME WEATHER VULNERABILITY ASSESSMENTS (June 15, 2023), https://www.ferc.gov/news-events/news/presentation-e-1-transmission-system-planning-performance-requirements-extreme.

- Address how resilience plans will be comprehensive (all-hazard planning) and synchronized with the utility's resource adequacy, capital improvement, security, and other long-term plans.
- Detail the scoping, scheduling, and budgeting required of all planned projects in advance of the regulatory review and approval process.
- Specify regulatory requirements and review processes for periodic progress reports, plan updates, and public outreach and communications.

Procedurally, regulatory approval of utility plans could be in the form of issuing a certificate of need (or public convenience and necessity) to justify projects and their technological and monetary scale and scope before implementation proceeds and expenditures are incurred. Certification would not confer a guarantee but is suggestive of *probable* recovery of capital and operating costs to ensure compliance, subject to subsequent regulatory audits and prudence reviews within and between rate cases.

The regulatory compact confers to jurisdictional utilities *a reasonable opportunity to earn a fair return* assuming efficient management.[101] Certification of need is consistent with this concept, while preapproved spending is not.[102] Regulators do not (micro) manage utility projects or operations of any kind and should not assume the associated risks, which, in effect, transfers them to ratepayers. Given their advantages of technical and operational knowledge, utilities should bear considerable responsibility for implementing resilience measures. Economic regulation imposes incentives for prudence and efficiency, and cost recovery is more likely for beneficial projects that are well planned, designed, and implemented. Section VII discusses cost recovery issues in more detail.

C. The Role of Torts in Resilience Planning

Tort litigation against public utilities for damages attributable to climate change, if not preempted by state utility regulation, is still reactive. It can be remedial if successful, but unlike resilience planning, it is neither forward-looking nor a substitute for public policy and regulatory oversight. Indeed, tort litigation can inform and validate the need for and content of rulemaking requiring proactive climate resilience planning by utilities.

Tort liability awards against utilities can and should motivate resilience planning and prudent action so that further liability can be averted and additional costs

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101. *See* BEECHER & KIHM, *supra* note 15, at 67. Regarding regulatory standards, *see* Missouri ex rel. Sw. Bell Tel. Co. v. Public Serv. Comm'n, 262 U.S. 276, 289-313 (1923); Fed. Power Comm'n v. Hope Nat. Gas Co., 320 U.S. 591 (1944).

102. For information on preapproval, see Russell J. Profozich et al., *Comm'n Preapproval of Util. Investments,* NAT'L REGUL. RSCH. INST. (Dec. 1981), https://ipu.msu.edu/wp-content/uploads/2016/12/Profozich-Burns-Hess-Commission-Preapproval-81-6-Dec-81.pdf; *see also* Scott Hempling & Scott H. Strauss, *Pre-Approval Commitments: When and Under What Conditions Should Regulations Commit Ratepayer Dollars to Util.-Proposed Capital Projects?*, NAT'L REGUL. RSCH. INST. (Nov. 2008), https://pubs.naruc.org/pub/5F3D50FA-1866-DAAC-99FB-55C8EF422EC8.

can be avoided.[103] Successful tort claims turn on a finding of a duty or standard of care that defendants owe to plaintiffs. According to conventional legal tort formulations, climate damages will be awarded against a public utility defendant if the known damages of accelerating climate change outweigh the forecastable costs of timely resilience measures.[104] Tort damage awards so determined are also relevant to subsequent utility choices about resilience measures and regulatory evaluation of prudence.

VI. Experience in Climate Resilience Planning

According to the Center for Climate and Energy Solutions, as of Spring 2023, thirty-three states had adopted "climate action plans" (Table 2) relevant to utilities and regulators.[105] To varying degrees, the plans "include greenhouse gas (GHG) emissions reduction targets and detail actions the state can take to help meet those goals" as well as "resilience strategies, clean energy targets, and economic and social goals."[106]

Table 2. State Action Plans and Reports[107]

	Previous	Latest
Arizona		2006
Arkansas		2008
California	2017	2022
Colorado	2019	2021
Connecticut	2018/2022	2021
Delaware	2014	2021
District of Columbia		2010
Florida		2008
Illinois	2007	2021
Iowa		2008
Kentucky		2011
Louisiana		2022

103. Some of the climate-related tort suits pending in the courts concern utilities' failure to mitigate climate change, but some of these claims, such as wildfire lawsuits, might also point to the lack of adaptation and resilience planning. On prudence and cost allocation associated with wildfires, *see* Petek, *supra* note 30.

104. *See* Thomas C. Galligan, *The Structure of Torts,* 46 FLA. ST. U. L. REV. 239, 496-97 (2022) ("At its most basic" a duty or standard of care in torts posits "a defendant has an obligation to the plaintiff to exercise reasonable care under the circumstances."). Instructive for purposes of efficient resilience planning is a calculus for determining when an existing duty of due care has been breached and damages are owing in the tort context. Articulated by Judge Learned Hand in United States v. Carroll Towing Co., 159 F.2d 169, 173 (2d Cir. 1947), that calculus posits that a duty of due care arises when PL>B, where P is the *probability* of injury or loss (L), L is the *gravity or severity* of injury or loss, and B is *burden or cost* to prevent L.

105. CTR. FOR CLIMATE & ENERGY SOL'S., U.S. STATE CLIMATE ACTION PLANS, (Nov. 2023), https://www.c2es.org/document/climate-action-plans/.

106. *Id*.

107. CTR. FOR CLIMATE & ENERGY SOL'S., *supra* note 105. No data were available for the District of Columbia.

Maine	2004	2020
Maryland	2015	2021
Massachusetts	2015	2022
Michigan	2009	2022
Minnesota	2015	2022
Montana		2020
New Hampshire		2009
New Jersey	2009	2020
New Mexico		Scheduled
New York		2022
Nevada		2020
North Carolina	2008	2019
Oregon	2010	2020
Pennsylvania	2019	2021
Rhode Island	2002	2022
South Carolina		2008
Vermont	2018	2021
Virginia		2008
Washington	2012	2014
Wisconsin	2008	2020

California[108] and New York[109] have adopted comprehensive approaches to climate resilience planning for regulated public utilities.[110] In New York, resilience planning with regulatory oversight was mandated for investor-owned utilities by state law in 2022 following the 2020 Sabin/EDF study.[111]

The New York statute requires investor-owned utilities to prepare and submit to state regulators climate-change vulnerability studies that "[e]valuate the electric corporation's infrastructure, design specifications, and procedures to improve un-

108. The California Public Utilities Commission devotes a web page to the issue, where it cites several orders intended "to integrate climate change adaptation matters in relevant CPUC proceedings." CAL. PUB. UTILS. COMM'N, CLIMATE ADAPTATION, https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/climate-change.

109. *See supra* note 102.

110. *See* CAL. FOURTH CLIMATE CHANGE ASSESSMENT, TECHNICAL REPORTS (Mar. 2023), https://climateassessment.ca.gov/techreports/; *see also* CONEDISON, CLIMATE CHANGE VULNERABILITY STUDY (Dec. 2019), https://coned.com/-/media/files/coned/documents/our-energy-future/our-energy-projects/climate-change-resiliency-plan/climate-change-vulnerability-study.pdf (Plan developed in response to New York PSC directive to respond to significant damage caused by Superstorm Sandy).

111. *See* Webb et al., *supra* note 7, at 13 (citing Con Edison settlement arising out of the New York Public Service Commission's Resiliency Collaborative). The Con Edison 2019 study resulting from the settlement "analyzed projected change in temperature, humidity, precipitation, sea level, and extreme weather in Con Ed's service territory over seven time periods spanning from 2020 through 2080," and identified safety and reliability risks to transmission lines and substations posed by these expected climate changes. *Id.* at 15. Many of the planning features described by the Sabin Center were incorporated into the New York statute enacted in 2022.

derstanding of the corporation's vulnerability to climate-driven risks, and shall include, but not be limited to, adaptation measures to address vulnerabilities and any other information deemed necessary by the commission."[112]

Some mandated resilience plans, such as those required under New York law, are comprehensive, requiring utilities to assess all climate vulnerabilities by location and implement actions to ensure infrastructure and operational resilience; others are focused on specific risks, such as wildfires or storm events, as well as prompt service restoration following interruptions. Some state, municipal, and member-owned (cooperative) utilities typically exempt from state utility commission oversight have also prepared comprehensive resilience plans. Examples include Seattle City Light[113] and the Long Island Power Authority.[114] Utilities ~~that are~~ not subject to commission jurisdiction can emulate resilience planning and practices from their regulated counterparts.

Economic regulation is mostly self-enforcing based on institutional legitimacy and acceptance of commission rulings. But here, too, regulators have a cudgel if utilities fail to comply with or adequately implement approved resilience plans. With variations, public utility commissions also have the authority to enforce their regulations and orders. Some regulators have statutory authority to issue fines for violations. The California Public Utilities Commission describes its enforcement program as "a variety of formal and informal means, including" formal investigations (preceded by staff investigations) that may include fines and other remedies, staff citations for violations, audits, and inspections, Administrative Consent Orders (ACO), Administrative Enforcement Orders (AEO), and a whistleblower program.[115] In some states, commissions must invoke the authority of the courts for enforcement.[116]

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112. N.Y. Pub. Serv. Law § 66 (29) (a-k) (Consol. 2022); *see* Proc. on Motion of the Comm'n Concerning Elec. Util. Climate Vulnerability Stud. and Plans, Case 22-E-0222 (N.Y. P.U.C. 2022), https://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={CA027C18-8246-47E7-A1A1-B2C096AC42C0.

113. *See* Seattle Action Plan, *supra* note 52.

114. *See* LONG ISLAND POWER AUTH., 2023 INTEGRATED RESOURCE PLAN, https://www.lipower.org/irp/; *see also* LONG ISLAND POWER AUTH., LIPA-PSEG LONG ISLAND 5-YEAR STRATEGIC ROADMAP 4, 29 (Mar. 29, 2023), https://www.lipower.org/wp-content/uploads/2023/03/2.6-Consideration-of-Approval-of-the-5-Year-Strategic-Roadmap.pdf (referencing intent to "[p]articipate in EPRI's Climate READi initiative to model and evaluate climate risks and resiliency plans using industry best practices").

115. CAL. PUB. UTIL. COMM'N, ENFORCEMENT AND CITATIONS (June 2023), https://www.cpuc.ca.gov/regulatory-services/enforcement-and-citations.

116. The Ohio Revised Code, for example, makes willful failure to comply with lawful orders of the state's PUC a statutory violation. *See, e.g.*, Ohio Rev. Code § 4905.56. The Ohio revised code authorizes the state commission to "supervise and regulate" both public utilities and railroads, but only expressly gives the commission direct authority to "enforce all orders relating to" railroad safety. *Id.* at § 4905.04. Instead, the state's Attorney General, "upon the request of the commission, shall commence and prosecute such action, or proceeding in mandamus, by injunction, or by other appropriate civil remedies in the name of the state." *Id.* at § 4905.60. The court then has the authority to order "proper" relief. *Id.*

VII. RISK AND REWARD: COST RECOVERY FOR RESILIENCE SPENDING

Achieving climate resilience will be very expensive regardless of who pays and how. But, failure to invest in climate resilience may soon be costlier to society and utilities in the long term. Urban areas face massive costs to construct sea walls and levees to protect people and infrastructure from rising sea levels and flooding.[117] Utilities may need to plan for relocating facilities along coastal areas and inland shorelines.[118] Undergrounding electrical power lines (new or conversions) might be justified under some conditions, but it is far more costly than stringing better-insulated power lines between above-ground utility poles.[119] The water sector's needs associated with water resource, stormwater, and energy management add to the substantial infrastructure investment needed to replace and upgrade aging water and wastewater infrastructure.[120] Building infrastructure to divert and store stormwater in urban areas will also be costly,[121] raising issues of affordability and equity, particularly in legacy cities.

Under the prevailing regulatory model and ratemaking construct, investor-owned utilities have inherent and considerable incentives favoring capital investments that expand the rate base on which returns are earned. The same strong motives influence decisions about spending for system reliability and climate resilience. Regulators and consumer advocates are rightly concerned about rising costs and the spending propensity of utilities, including favoring capital expenditures over operating expenditures and "gold-plating" over more economical alternatives.[122]

Indeed, overspending on resilience is as much a risk as underspending. Utilities should be expected to evaluate and compare technological, operational, and managerial alternatives in terms of feasibility and cost-effectiveness.[123] Competitive bidding or collaborative partnerships could be used for procurement and project management. Sharing experience in climate resilience planning can offer lessons learned and promote the diffusion of legal processes, technical knowledge, and sound policies and practices across regulatory jurisdictions.

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117. Geoff Dembicki, *The Progressive Way to Save Cities from Superstorms*, THE NEW REPUBLIC (Aug. 2, 2023), https://newrepublic.com/article/174664/progressive-way-save-cities-superstorms.

118. *See, e.g.*, Climate Change Impacts on Coasts, EPA, https://www.epa.gov/climateimpacts/climate-change-impacts-coasts (last visited Apr. 17, 2024).

119. *See* EIA, POWER OUTAGES OFTEN SPUR QUESTIONS AROUND BURYING POWER LINES (July 25, 2012), https://www.eia.gov/todayinenergy/detail.php?id=7250; *see generally* Peter H. Larsen, *A Method to Estimate the Costs and Benefits of Undergrounding Elec. Transmission and Distrib. Lines*, 60 ENERGY ECON. 47, 47-61 (2016).

120. CONGRESSIONAL RESEARCH SERVICE, DRINKING WATER INFRASTRUCTURE NEEDS: BACKGROUND AND ISSUES FOR CONG. 8, 10 (Dec. 18, 2023), https://crsreports.congress.gov/product/pdf/R/R47878.

121. *See* EPA, CLIMATE ADAPTATION AND WATER UTILITY OPERATIONS (June 14, 2023), https://www.epa.gov/arc-x/climate-adaptation-and-water-utility-operations (adaptation strategies include aquifer storage and recovery, increased municipal storage capacity, and flood barriers).

122. *See* Costello, *supra* note 16 (discussing concern about "gold plating" resilience measures); *see also* Beecher, *supra* note 15, at 41, 47-50 (discussing utility spending propensities).

123. *See* Costello, *supra* note 16.

Bruzgul and Weisenfeld recommend "flexible adaptation pathways" to reduce regulatory uncertainty and allow for changing course as conditions change.[124] Regulatory review and approval processes can be specified without prejudging regulatory treatment or outcomes. Resilience mandates and standards promulgated by statutes or rules can establish a presumptive need for resilience planning; resilience plans can establish a presumptive need to incur capital and operating costs and provide the basis for evaluating prudence in spending. Following plan approval, processes are needed by which utilities can give notice of major investments and operational actions so that regulators can monitor implementation progress and outcomes. Regulators should also hold utilities to account for compliance in plan-specific and rate-case prudence reviews, including penalization for non-compliance.

Whether utility spending comports with an approved climate resilience plan should become a relevant and possibly determinative consideration in rate cases. Compliance with a regulator-approved plan would create a rebuttable presumption that, for ratemaking purposes, prudently incurred expenditures for approved projects shown to be beneficial will be recoverable in regulated rates charged to customers[125] or by other available means (including tax-supported funding).[126]

Utility regulators will need to be vigilant about prudent and efficient compliance with resilience plans and related mandates and seek to minimize the risk of technological obsolescence. Stranded investments compound resilience costs and do not produce value for utilities, ratepayers, or society. Restrictions on retroactive ratemaking also limit the ability to revisit costs once approved for inclusion in rates.[127] Utilities are in the best position to formulate resilience strategies and should face strong incentives to manage risks, including the possibility of foregone cost recovery or lower returns. Flexible infrastructure design that limits large (lumpy) and nonfungible investments is an adaptive strategy with technological and economic advantages in the context of uncertainty.[128]

VIII. CONCLUSION

We find ourselves beyond the tipping point and facing the mounting toll of climate change. Today's investments will lessen tomorrow's costs. The risks are

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124. Bruzgul & Weisenfeld, *supra* note 98, at 10-11.

125. Many states apply a "used and useful" standard for recovery of capital investments, but it is not a constitutional requirement. *See, e.g.,* Jersey Cent. Power & Light Co. v. FERC, 810 F.2d 1168, 1175 (D.C. Cir. 1987). Regulators have allowed utilities to recover prudent investments in failed projects that, for reasons ruled to be beyond their control, never became used and useful. *Id*. at 1184-85. There may well be climate resilience projects that, while prudently undertaken, later become unnecessary or outmoded in the face of new conditions or technologies.

126. Janice Beecher, *Funding and Fin. to Sustain Pub. Infrastructure: Why Choices Matter*, MICH. ST. UNIV. 4 (Jan. 15, 2021).

127. *See, e.g.,* Pub. Util. Comm'n v. FERC, 988 F.2d 154, 161 (9th Cir. 1993) ("[T]he rule against retroactive ratemaking prevents utilities from collecting revenues to compensate for [prior over or] underrecoveries….").

128. *See* RICHARD DE NEUFVILLE & STEFAN SCHOLTES, FLEXIBILITY IN ENG'G DESIGN, THE MIT PRESS (2011); *see also* ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT, CLIMATE-RESILIENT INFRASTRUCTURE 2 (2018), https://www.oecd.org/environment/cc/policy-perspectives-climate-resilient-infrastructure.pdf (noting that "[f]lexible, adaptive approaches to infrastructure can be used to reduce the costs of building climate resilience given uncertainty about the future.").

known and actionable, and rationales for inaction are no longer tenable. Climate science confirms that despite mitigation efforts, heat-trapping gases will continue to cause rising sea levels and increasingly extreme weather events, with widespread economic and social consequences. Prudence calls for adaptive and *resilient* utility infrastructure. It is manifestly urgent for regulators to exercise their rulemaking authority and mandate enforceable climate resilience planning by public utilities to ensure the continuity of services vital to the public interest.