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Planned Adaptation as an Electric Regulatory Response
to Extreme Weather Events in the United States

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30 Introduction

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32 The past decade has seen the most destructive string of natural disasters in recorded
33 U.S. history, in terms of total economic damage. This has largely been viewed as a preview
34 of what's in store over the next several decades, as a changing climate intensifies the
35 magnitude and quantity of extreme storms and wildfires, in particular.

36 At the same time, the past decade has seen a rush of political, policy, and industrial
37 steps towards decarbonization of the U.S. electric power sector — a move that is regarded as
38 a critical component of any effort to reduce U.S. greenhouse gas emissions to zero before 2050,
39 the target proposed by the IPCC's October 2018 *Special Report on Global Warming of 1.5°C*.
40 What exactly the process of decarbonizing U.S. power will look like remains to be seen —
41 though it will likely be driven by some combination of wind, solar, battery storage, advanced
42 nuclear, and carbon-emitting generation sources, alongside carbon-capture technologies.
43 However, a broad consensus seems to exist across the modeling literature that it will require
44 the construction of nearly 2 terawatts of new generation capacity, along with the
45 transmission and distribution infrastructure needed to enable it.

46 While this would be a daunting task under the best of circumstances, it's important
47 to remember that the (re)building of a decarbonized power system will occur over the next
48 thirty years — a period where the impacts of climate change that we are already feeling are
49 expected to intensify. Thus, we have to consider not only how we can decarbonize the U.S.
50 power system, but also how we can bend that process in a way that incentivizes resilience
51 against the impacts of climate-enhanced extreme weather — a challenge characterized by its
52 uncertainty.

53 In this paper, we will seek to consider the role that planned adaptation — regulatory
54 processes that “revise rules when relevant new knowledge appears, and take steps to produce
55 such improved knowledge”¹ — has played in the ways that U.S. utility regulators have
56 responded in the aftermath of climate-driven extreme weather events. We will examine three
57 cases from the past, remarkable decade of extreme weather — Hurricane Maria, the
58 Northern California wildfires of 2017-2019, and Superstorm Sandy — for insight into how
59 regulators have attempted to make *learning* a key part of existing electric regulatory
60 processes.

¹ McCray, Oye, and Petersen, “Planned Adaptation in Risk Regulation.”

61 **Hurricane Maria**

62

63 In September 2017, Maria slashed across the Commonwealth of Puerto Rico as a
64 Category 4 storm. The strongest storm to hit Puerto Rico in nearly a century, and the third-
65 most devastating Atlantic hurricane to ever hit the United States, Maria caused more than
66 \$90 billion in damage, and took over 3,000 lives.

67 And in its wake, Puerto Rico endured the largest electric power blackout in U.S.
68 history, and the second largest ever in the world.² It would take 189 days to bring power back
69 to 95% of Puerto Ricans and 328 days — nearly eleven months — before power was fully
70 restored across the island.

71 While the storm and the ensuing blackout had numerous causes, Puerto Rico’s post-
72 Maria woes — and the woes of PREPA, its much-maligned public electric utility — can be
73 traced back to its roots as one of America’s enduring colonial possessions. Since being
74 annexed by the U.S, Puerto Rico has been caught in a sort of superposition of political and
75 legal status — formally part of the U.S., with its citizens Americans by birth, but subject to
76 decidedly second-class status under U.S. administrative and legal structures.

77 Over the past decade, Puerto Rico has been wracked by financial crisis after financial
78 crisis: from the loss of its manufacturing industry, to an ongoing debt crisis. Together, the
79 commonwealth’s financial troubles have undermined its institutions’ capability to deal with
80 major exogenous challenges like the aftermath of Hurricane Maria.

81 To truly understand Puerto Rico’s modern financial troubles, we must first revisit a
82 few key pieces of legislation that laid the foundation for the modern U.S.-Puerto Rico
83 relationship.

84 Following the Spanish-American War, Puerto Rico’s first civilian government under
85 U.S. territorial rule was established by the Organic Act of 1900. Also known as the Foraker
86 Act, the law exempted the territory from most federal taxation, while giving it the power to
87 levy taxes and issue public debt in the form of bonds.³

88 The Puerto Rican Federal Relations Act of 1917, commonly known as the Jones-
89 Shafroth Act, built on the Foraker Act. It granted U.S. citizenship to all Puerto Ricans, and
90 established an executive branch and bicameral legislature for the territory. It also contained

² Houser and Marsters, “The World’s Second Largest Blackout.”

³ Organic Act of 1900.

91 this key passage, which has arguably been among the most impactful on the trajectory of
92 Puerto Rico’s economy, after citizenship:

93 “...all bonds issued by the government of Porto Rico, or by its authority, shall be
94 exempt from taxation by the Government of the United States, or by the government
95 of Porto Rico or of any political or municipal subdivision thereof, or by any State, or
96 by any county, municipality, or other municipal subdivision of any State or Territory
97 of the United States, or by the District of Columbia.”⁴

98 This is what has come to be known as the “triple tax-exemption,” a quirk of federal law which
99 means that Puerto Rican public debt — issued by the Commonwealth’s government, public
100 corporations (like PREPA), or one of its 78 municipalities⁵ — is exempt from federal, state,
101 and local taxes, regardless of where in the U.S. the bondholder lives. While income earned
102 from municipal bonds is generally exempt from federal income taxes, the exemption from
103 state taxes usually only applies to bonds that are issued in that particular state. This means
104 that Puerto Rican bonds, which benefit from a nationwide triple tax-exemption thanks to the
105 Jones-Shafroth Act, were very attractive to fixed-income investors looking to enhance their
106 profit margins.

107 Just three years later, the same Senator Wesley Jones would lead the passage of the
108 Merchant Marine Act of 1920 (confusingly known as the Jones Act). Among other provisions,
109 the Act requires that all goods shipped by boat between ports within the U.S. be carried on
110 U.S. flagged ships, which are constructed in the U.S., owned by U.S. citizens, and crewed by
111 U.S. citizens and/or permanent residents. This would come to prove quite burdensome for an
112 island U.S. territory like Puerto Rico, which is almost entirely dependent on imports —
113 especially when it comes to fuel for its fossil-fueled electric generators, and the kinds of
114 specialized electric system equipment it would find itself needed to replace *en masse* in the
115 wake of Hurricane Maria.

116 The next major legislative component of Puerto Rico’s financial evolution came in
117 1976, with the passage of Section 936 of the Internal Revenue Code. While the federal
118 government had long used tax policy to try and incentivize commerce, manufacturing, and
119 other business activity between the mainland U.S. and the territories, §936 took that effort

⁴ Puerto Rican Federal Relations Act of 1917.

⁵ Unlike U.S. states, Puerto Rico does not have county-level divisions, but is rather divided into 78 municipalities.

120 to a new level. The provision exempted all income earned by U.S. corporations through
121 activities based primarily in Puerto Rico and the territories from federal corporate income
122 taxes, and made the income deductible from Puerto Rico’s corporate income tax.⁶ This was
123 extremely attractive to American companies, particularly those in the pharmaceutical and
124 manufacturing sectors, and the island’s economy boomed.

125 However, by the 1990s, §936 had come to be viewed as a loophole for tax-evading
126 corporations. In 1996, President Clinton signed a 10-year phase out of the provision into law,
127 which would completely eliminate it by the end of 2005.⁷ The impact on Puerto Rico’s economy
128 was readily apparent. One study found that manufacturing wages across Puerto Rico dropped
129 by 16.7% from 2005 to 2012 as a result of the §936 phaseout, while reducing the number of
130 manufacturing establishments in the commonwealth by between 18.7% and 28.0% over the
131 same period.⁸

132 The economic decline coincided with a ramp up in debt spending by Puerto Rico’s
133 government. Since a 1974 executive opinion on a quirk in the constitution’s balanced budget
134 amendment, the commonwealth’s government had routinely issued bonds in order to raise
135 funds needed to balance Puerto Rico’s budget. This essentially meant that the commonwealth
136 was constantly borrowing money to fund its operating budget — a practice that the U.S.
137 Government Accountability Office has described as “unusual” and a “red flag” for credit
138 ratings agencies. By the end of 2005, Puerto Rico had roughly \$35 billion in outstanding
139 bonded debt. However, that number would spike over the next decade. In 2006, the
140 government created a new financing mechanism backed by a newly-implemented sales tax,
141 that essentially allowed it to issue more bonds, in order to raise funds to pay off its existing
142 bonds.⁹

143 Combined with an increased reliance on the issuance of debt to finance its operations
144 after the phase out of §936, this left Puerto Rico with nearly \$70 billion in debt by 2015 —
145 roughly the same amount as its GNP. At the same time, the costs of servicing all this debt
146 had grown to more than \$5 billion annually by 2014, equal to over 15% of the commonwealth’s

⁶ Puerto Rico And Possession Tax Credit [Repealed].

⁷ Greenberg and Ekins, “Tax Policy Helped Create Puerto Rico’s Fiscal Crisis.”

⁸ Feliciano and Green, “US Multinationals in Puerto Rico and the Repeal of Section 936 Tax Exemption for U.S. Corporations.”

⁹ U.S. Government Accountability Office, “Puerto Rico: Factors Contributing to the Debt Crisis and Potential Federal Actions to Address Them,” 22–24.

147 total revenue. Facing choices between basic services and servicing its growing debt burden,
148 Puerto Rico missed a scheduled bond payment in August 2015, and subsequently defaulted
149 on more than \$1.5 billion in debt. By the end of 2016, Puerto Rico owed roughly \$40.8 billion
150 in primary government debt, and \$24.3 billion in debt for its publicly owned corporations —
151 including \$9.1 billion for PREPA. It also separately owed \$44.9 billion in unfunded pension
152 liabilities, for a total of nearly \$110 billion in outstanding debt.¹⁰¹¹

153 The U.S. has a long history of putting in place protections to ensure that government
154 organizations are able to seek protection in the face of crippling financial troubles and debts,
155 like those faced by Puerto Rico. And while state governments cannot file for bankruptcy, their
156 constituent agencies, publicly-owned corporations, and municipalities can, by seeking
157 protection under Chapter 9 of the U.S. Bankruptcy Code, which has existed in various forms
158 since the Great Depression. However, in an as-yet unexplained quirk of legislative history,
159 Senator Strom Thurmond added an amendment to an obscure 1984 bankruptcy reform bill
160 that specifically singled out Puerto Rico and Washington, D.C., and their constituent entities,
161 as ineligible for Chapter 9 bankruptcy protection — a protection that had been available to
162 them up to that point.¹²¹³ This meant that thirty years later, as Puerto Rico and its public
163 corporations (including PREPA) teetered on the verge of defaulting on their debts, they were
164 unable to avail themselves of the Chapter 9 bankruptcy protections available to nearly every
165 other U.S. state and territory.

166 In response to this precarious situation, Congress passed the Puerto Rico Oversight,
167 Management, and Economic Stability Act (PROMESA), which was signed by President
168 Obama in June 2016.¹⁴ The Act placed a halt on the onslaught of legal claims being filed
169 against Puerto Rico by, among others, hedge funds that had bought copious amounts of
170 Puerto Rican debt on the municipal bond market at extremely low prices, with the hopes of
171 extracting profits via litigation — referred to derisively in Puerto Rico as “vulture funds,” for
172 a perceived similarity to vultures circling a wounded animal.¹⁵

¹⁰ U.S. Government Accountability Office, “U.S. Territories: Public Debt Outlook – 2019 Update,” 9.

¹¹ U.S. Government Accountability Office, “Puerto Rico: Factors Contributing to the Debt Crisis and Potential Federal Actions to Address Them,” 14.

¹² Bankruptcy Amendments and Federal Judgeship Act of 1983.

¹³ Greenberg, “Mystery: Strom Thurmond, Puerto Rico and Bankruptcy Protection.”

¹⁴ Wicker, Puerto Rico Oversight, Management, and Economic Stability Act (PROMESA).

¹⁵ Barron, “The Curious Case of Aurelius Capital v. Puerto Rico.”

173 In the place of the existing legal process, PROMESA created a Financial Oversight
174 and Management Board (FOMB) — a seven-member, presidentially-appointed commission
175 with sweeping power to oversee Puerto Rico’s fiscal affairs, and to facilitate the resolution
176 and restructuring of its debts. It also created two processes for debt resolution — Title III,
177 similar to Chapter 9 municipal bankruptcies, and Title VI, a form of arbitrated negotiation
178 between the debtors and the creditors.¹⁶

179 In the intervening four years, Puerto Rico has managed to restructure what had
180 become \$74.7 billion in general debt and \$54.5 billion in pension liabilities, securing a 33%
181 reduction in the overall debt, including a 27% reduction in PREPA’s debt burden from \$10.1
182 billion to \$7.4 billion.¹⁷

183 However, at the same time, the FOMB has pushed the government — and, by
184 extension, PREPA — to impose deep-cutting austerity measures under PROMESA, including
185 a 30% loss of its workforce and a virtual halt on new capital projects.

186 This was particularly a problem for PREPA, because it needed that capital to begin
187 rebuilding its aging power system. Puerto Rico’s grid is built around eight, aging oil-fired
188 generation plants clustered on the island’s northern and southern coasts. Four decades old,
189 on average, the plants require a constant diet of heavy fuel oil — which must be shipped to
190 the island. The island’s power system is also highly asymmetrical: 70% of its generating
191 capacity is in large fossil plants on the southern shore, while 70% of its population (and thus,
192 electrical demand) is along the northern shore, near the capital city of San Juan. This means
193 that power must be transported across the island’s rugged, mountainous interior by
194 transmission lines that are hard to access and service.¹⁸

195 These are the lines that Maria destroyed most in their entirety, along with more than
196 80% of the distribution lines across the island that brought power into homes and
197 communities. And after the storm hit, PREPA — crippled by debt, a lack of capital,
198 mismanagement, and a hollowed-out workforce — was simply unable to handle the task of
199 restoring power, which eventually had to be handed over to the U.S. Army Corps of
200 Engineers.

¹⁶ U.S. Government Accountability Office, “U.S. Territories: Public Debt Outlook – 2019 Update,” 10.

¹⁷ Walsh and Russell, “\$129 Billion Puerto Rico Bankruptcy Plan Could Be Model for States.”

¹⁸ Fisher and Horowitz, “Expert Report: State of PREPA’s System.”

201 One would imagine that PREPA should have planned for an event like this — or that
202 the government should have forced them to — and in fact, they did... sort of. In 2014, the
203 Commonwealth’s Legislative Assembly passed a law requiring that PREPA submit to an
204 Integrated Resource Planning process — a common practice among electric utilities in the
205 U.S., where they submit 20-year plans of generation and grid projects to be completed, for
206 examination and approval by their regulators and community stakeholders. Interestingly for
207 our purposes, the IRPs must be updated regularly — in PREPA’s case, every three years. In
208 theory, the process requires PREPA and its regulator to conduct a tri-annual review of the
209 ground truth of the needs of the utility and its electric system, as well as the challenges it
210 faces, and then revise the entire long-term plan for the utility’s system in accordance. This
211 would mean that every generator, transmission line, and substation PREPA is authorized to
212 construct should, in theory, be informed by a regular review that examines the utility’s
213 performance since the last review, considers its current state, and makes educated inquiries
214 into its future prospects. This bootstrapped version of planned adaptation seems like it ought
215 to yield substantial progress — but, as so often happens, the reality has proven rather
216 complicated.

217 In 2016, PREPA submitted its first IRP — a “stay the course” plan, that essentially
218 sought to keep the island’s aging, under-maintained power system (which already had some
219 of the worst outage numbers in the country) operational with moderate updates.

220 Three years later, in the wake of Maria, PREPA submitted an updated plan — a plan
221 which, in the face of the utility’s continued financial woes, looked largely the same.¹⁹ The key
222 difference was the proposal of a microgrid system, which would enable PREPA’s
223 transmission and distribution networks to segment themselves off, in the event that one or
224 more were damaged, in order to prevent a Maria-style cascading failure — an extension of
225 the restoration work that was done to rebuild the transmission and distribution system after
226 the storm.

227 However, as the Environmental Defense Fund noted rather incredulously in a legal
228 brief submitted as part of the 2019 IRP process, PREPA sought to power these microgrids
229 with the same kinds of large, centralized generation plants (swapping the old oil for natural
230 gas) that were cut off during Maria. It also failed to approach anything resembling the targets
231 for emissions reductions set out by the state government, which sought a 100%

¹⁹ Siemens Power Technologies International and Siemens Industries, “Puerto Rico IRP 2018-2019.”

232 decarbonization of the power system by 2050.²⁰ In their view, PREPA’s failure here was a
233 failure of imagination — one imposed by a legacy of financial instability, and the daunting
234 task of trying to figure out how to decarbonize a grid that is just barely holding together, to
235 begin with. While the regulatory process set forth in 2014 forced PREPA to make an effort to
236 periodically reexamine and learn from its experiences, it alone cannot eliminate the
237 underlying challenges that the utility faces.

238 While this IRP is still going through regulatory approval, we’ve already had a preview
239 of what the impacts of this failure of imagination could look like. In January 2020, the island
240 was struck by a magnitude 6.5 earthquake, which destroyed the Costa Sur power plant on
241 the island’s southern coast. While the repairs to the transmission and distribution systems
242 made recovery easier, the blow to a keystone of Puerto Rico’s centralized generation system
243 meant that the island was subject to a cascading outage when Costa Sur failed. However,
244 unlike after Maria, power was fully restored after just over a week.

245 From Maria, we see that planned adaptation alone cannot overcome deeply rooted
246 structural challenges. While setting up an IRP process that forced PREPA to periodically
247 reconsider its plans for Puerto Rico’s power system was an important step, it failed both to
248 consider the stresses that PREPA and the commonwealth were already under, and therefore
249 still yielded a less-than-optimal plan for the utility’s future.

²⁰ Environmental Defense Fund, “Final Brief in Re: Integrated Resource Plan for the Puerto Rico Electric Power Authority.”

250 Northern California wildfires

251

252 California's wildfires have always been a terrible sight to behold, but the fires that
253 swept the northern part of the state in 2017 and 2018 were by far the worst on record.

254 The 2017 wildfire season in California was the most destructive in nearly a decade.
255 From April through December, the state saw 9,270 fires break out. Together, they consumed
256 an estimated 1,548,429 acres of land, damaged or destroyed 10,280 structures, and claimed
257 47 lives.

258 Both the death toll and the damage exceeded that caused by the preceding nine fire seasons
259 years combined, with 2017 becoming the most destructive season on record at the time. In
260 fact, five fires that broke out in 2017 remain among the top twenty most destructive fires on
261 record in the state.²¹²²

262 The fires were spread out across the state for the majority of the year, but a burst of
263 strong Santa Ana winds in December set off a cluster of wildfires in Southern California
264 (including the 280,000 acre Thomas fire, the largest on record at the time) that forced the
265 evacuation of more than 280,000 people. Altogether, the 2017 fires caused an estimated \$18.7
266 billion in damages.²³

267 Following on the heels of the destruction of 2017, 2018 saw the worst wildfire season
268 in California history, by nearly every measure. From February through November, the 7,639
269 fires burning across the state consumed 1,963,101 acres of land, destroyed or damaged 24,226
270 structures, and claimed 100 lives. Altogether, the 2018 fires caused an estimated \$24.5 billion
271 in damages.²⁴

272 This made the 2018 wildfire season the largest, most damaging, and deadliest that
273 California has seen in nearly a century of detailed recordkeeping. The Mendocino Complex
274 Fire, formed by the merging of two fires that burned across four Northern California counties,
275 became the largest ever recorded in the state. From its ignition in late July, to its
276 containment on November 7th, it burned a stunning 459,123 acres.²⁵²⁶

²¹ California Department of Forestry and Fire Protection, "2017 Fire Season."

²² California Department of Forestry and Fire Protection, "Top 20 Most Destructive California Wildfires."

²³ National Centers for Environmental Information, "U.S. Billion-Dollar Weather & Climate Disasters: 1980-2020," 3.

²⁴ National Centers for Environmental Information, 2.

²⁵ California Department of Forestry and Fire Protection, "2018 Fire Season."

²⁶ California Department of Forestry and Fire Protection, "Top 20 Largest California Wildfires."

277 The containment of the Mendocino Complex fire was seen by many as the end of what
278 was already at that point “California’s worst wildfire season ever.” However, the very next
279 day, a 96-year-old hook on a transmission line in the Sierra Nevada foothills failed —
280 sparking what would come to be known as the Camp Fire.

281 By the time it was contained two weeks later, the Camp Fire would become the world’s
282 most expensive natural disaster of 2018, and the deadliest wildfire in California’s history. In
283 the months and years that followed, the aftermath of the Camp Fire would send the largest
284 investor-owned electric utility in the country into bankruptcy — prompting a frantic scramble
285 to build resilience against the wildfire risks that California’s aging power system posed in an
286 increasingly hostile climate.

287 However, to call the Camp Fire a “natural” disaster feels like a bit of a misnomer, and
288 not just because of climate change. For while the role of climate change in exacerbating the
289 conditions that make wildfires more likely has been well-documented in the literature, the
290 Camp Fire had a far more proximate cause: an electric transmission system that hadn’t been
291 designed to deal with the extreme weather it now faced, and its owner, the Pacific Gas and
292 Electric Company.

293 The most devastating tragedies often begin with the smallest of failures. In this case
294 it was “a 3-inch hook purchased for 56 cents around the end of World War I,” manufactured
295 by the Ohio Brass Company around 1918.²⁷ Initially a parts supplier for horse-drawn
296 carriages, the firm also made parts for some of the first electric transmission lines in the
297 United States.

298 The hook in question, known as a C-hook, was attached at one end to transmission
299 tower 27/222, which was constructed in 1921 in a sparsely populated region outside what
300 would later become the small town of Pulga, California. Tower 27/222 was just one of several
301 on the Caribou-Palermo transmission line, constructed in 1921 to carry hydroelectric power
302 by the Great Western Power Company — today, Pacific Gas and Electric (PG&E), the main
303 utility serving northern California. The 56-mile transmission line is one of the oldest in the
304 nation, part of a system of hydroelectric powerhouses and transmission lines stretching into
305 the Sierra Nevada foothills, known as the “Stairway of Power.”²⁸

²⁷ Gold and Blunt, “This Old Metal Hook Could Determine Whether PG&E Committed a Crime.”

²⁸ Blunt and Gold, “PG&E Delayed Safety Work on Power Line That Is Prime Suspect in California Wildfire.”

306 The other end of the C-hook was attached to a series of bell-shaped ceramic insulators
307 connected in series — which were, in turn, connected to a 115 kV electric transmission line.

308 In the 96 years between 1921 and November 8, 2018, that C-hook was under a great
309 deal of stress. Between the movements of Tower 27/222 and the gyrations of the Caribou-
310 Palermo line in the high winds of the Feather River Valley, the constant motion wore through
311 the hook’s WWI-era galvanized iron — about 70-80% of the way through.²⁹

312 Early on the morning of November 8th, that C-hook gave way, sending the
313 transmission line swinging away from its fixed position on the tower, and causing an arc of
314 electricity that ignited some dry vegetation. At 6:33 am PST, a PG&E worker called in a
315 sighting of smoke outside Pulga. Twenty-four hours later, 85 people were dead and the town
316 of Paradise, California no longer existed.³⁰

317 In the exhaustive wave of investigations that followed the Camp Fire, the California
318 Department of Forestry and Fire Protection (CAL FIRE) and the California Public Utilities
319 Commission (CPUC) found that the Camp Fire was a direct result of PG&E’s failure to
320 properly maintain the 96 year old Tower 27/222, and to identify the weakened C-hook before
321 it failed.³¹

322 In the year and a half since the Camp Fire devastated Paradise, PG&E’s role in
323 starting the fire has been firmly established. At the same time, it has become clear that the
324 Camp Fire was far from an aberration.

325 Over the course of 2018, investigators with CAL FIRE determined that PG&E
326 transmission and distribution lines were responsible for causing 17 major fires during the
327 2017 wildfire season.³²³³ And in June 2019, they formally confirmed what we learned above
328 — PG&E’s equipment was responsible for starting the Camp Fire, as well. The investigators’
329 overwhelming judgement was that the utility had been negligent in dealing with the wildfire
330 risks posed by its power system.

331 However, PG&E’s troubles with wildfire go far beyond those 18 major fires in 2017
332 and 2018. We examined regulatory disclosures that PG&E was required to make to CAL

²⁹ California Public Utilities Commission, “Incident Investigation Report for 2018 Camp Fire,” CAMP-0011, CAMP-0020.

³⁰ Gold and Blunt, “This Old Metal Hook Could Determine Whether PG&E Committed a Crime.”

³¹ “CAL FIRE Investigators Determine Cause of the Camp Fire.”

³² Stelfox, “CAL FIRE Investigators Determine Causes of 12 Wildfires in Mendocino, Humboldt, Butte, Sonoma, Lake, and Napa Counties.”

³³ Stelfox, “CAL FIRE Investigators Determine the Cause of the Cascade Fire.”

333 FIRE, which indicate that the utility’s equipment was responsible for starting 1,986 fires
334 across the state from June 2014 (when the reporting requirement began) through the end of
335 2018.³⁴ This indicates that the 18 major fires that have come to define PG&E’s association
336 with the 2017 and 2018 wildfire seasons were merely the tip of the iceberg — nearly two
337 thousand wildfire disasters that thankfully failed to materialize.

338 PG&E is the largest investor-owned utility in the United States, covering a 70,000
339 square mile service area — larger than the entire state of Florida.³⁵ It has 106,681 circuit
340 miles³⁶ of electric distribution lines and 18,466 circuit miles of interconnected transmission
341 lines, and serves around 16 million people through 5.4 million customer accounts.³⁷ And yet,
342 while it began the decade as a national leader in electric system decarbonization, PG&E
343 ended it by pleading guilty to 84 counts of manslaughter while in bankruptcy proceedings.
344 How did this happen?

345 Based on a review of investigative reports from CAL FIRE’s investigative materials,
346 publicly-released court documents and regulatory proceedings, and a dogged investigation by
347 the *Wall Street Journal*,³⁸ we are able to piece together a nearly two-decade-long series of
348 events that laid the groundwork for the disastrous fires of 2017 and 2018, including the Camp
349 Fire.

350 We find that as the 2010s came to a close, PG&E was being pulled in too many
351 directions, facing a whole new slate of challenges without the institutional capability to meet
352 them. The utility was struggling to deal with a history of accidents and the maintenance of a
353 sprawling power system with components that dated back to 1908, while simultaneously
354 racing to meet California’s nation-leading standards for electric system decarbonization. At
355 the same time, it was dealing with financial pressures and continuing a long legacy of shoddy
356 maintenance procedures.

³⁴ Pacific Gas and Electric Company, “PG&E Fire Incident Data, 2014-2018.”

³⁵ Pacific Gas and Electric Company, “Service Territory Map.”

³⁶ In electric power, “circuit miles” are equal to the distance travelled by a given transmission or distribution route multiplied by the number of independent electrical circuits present on that route (generally one or two).

³⁷ Pacific Gas and Electric Company, “Company Profile.”

³⁸ On May 4, 2020, the staff of the *Wall Street Journal* were named finalists for the Pulitzer Prize in National Reporting for the series that this section draws heavily from, which was cited for “showing how a California utility’s neglect of its equipment caused countless wildfires, including one that wiped out the town of Paradise and killed 85 people.”

357 This not imply that decarbonization efforts were a driver of the fires — as we learned,
358 the Caribou-Palermo line had been carrying emission-free electricity from the Caribou
359 hydroelectric powerhouse since 1921, decades before the phrase “climate change” even
360 entered the American lexicon.

361 But to paraphrase the *Wall Street Journal’s* Pulitzer-finalist investigation into the
362 events that led to the Camp Fire: PG&E appears to have been so busy worrying about the
363 past and planning for the future, that the risks of the present snuck up on it.

364 Our examination thus far of PG&E’s chronic missteps paints a compelling, but
365 incomplete picture of the underlying drivers of the 2017-2018 California wildfires. The
366 missing piece? The role of California state government, particularly the California Public
367 Utilities Commission.

368 Over the past 23 years, PG&E has paid more than \$2.6 billion in state and federal
369 fines and lawsuit settlements, for a pattern of behavior including failures to adequately
370 maintain its gas and electric systems, insufficient candor and actively misleading regulators,
371 contaminating groundwater with carcinogens,³⁹ failing to meet required targets, prohibited
372 and unethical political activities including improper interactions with CPUC staff, and a
373 litany of safety violations.^{40,41}

374 Yet as we will see, even after a quarter-century of chronic violations by PG&E, CPUC
375 struggled to oversee the nation’s largest investor-owned-utility in a timely and effective
376 manner.

377 At the turn of the 2010s, California’s state government was all-in on climate action
378 and electric system decarbonization. Less than eight months after the San Bruno explosion,
379 Governor Jerry Brown signed legislation increasing California’s renewable portfolio standard
380 to 33% of electric generation by 2020. At the same time, as we’ve previously noted, PG&E
381 was continuing to spend billions on renewable energy procurement, to keep abreast of the
382 RPS as customer rates continued to rise.

383 The California Public Utilities Commission is the largest state public utility regulator
384 in the nation, double the size of the next largest (Virginia’s). In addition to electric and

³⁹ After polluting a small town’s water supply with carcinogenic hexavalent chromium, PG&E paid \$333 million in 1996 to settle *Anderson, et al. v. PG&E* — a class-action lawsuit that would go on to bring a legal clerk named Erin Brockovich to national prominence.

⁴⁰ Eastwood, “PG&E’s Long Record of Run-Ins With Regulators.”

⁴¹ Eastwood, “PG&E Penalties and Settlements Through the Years.”

385 natural gas systems, the Commission also oversees a range of industries spanning everything
386 from railroads, to mobile homes, to ridesharing. But in interviews, former CPUC officials
387 have argued that the commission’s focus on decarbonization over the past two decades, driven
388 by political leaders in Sacramento, has crowded out the regulator’s already-anemic safety
389 efforts.⁴²

390 Two months after Brown signed the RPS increase into law, the Independent Review
391 Panel assembled by CPUC to examine the San Bruno explosion released its assessment of
392 both PG&E and CPUC’s performance in the years leading up to the explosion. The Panel
393 noted CPUC’s “long-standing reputation for policy innovation” especially when it came to
394 climate change and renewable energy development. However, it noted that as a result of its
395 expansive policy focus, CPUC lacked “unanimity of view regarding how the agency’s
396 resources should be allocated, what issues should become the primary agenda of the
397 Commissioners, what skills are needed within the Commission, and what areas provide the
398 best promotional paths for talented individuals.”

399 While consider CPUC’s lack of a unified policy focus, the Panel did note one point upon
400 which the Commissioners were, in fact, unanimous: “they do not focus on the Commission’s
401 safety mandate – unless there is a problem escalated to them.”⁴³

402 This fundamentally reactive approach to safety issues is exemplified by CPUC’s
403 response to the onset of an unprecedented drought beginning in 2011.

404 Much of PG&E’s spending and investment on safety and maintenance is overseen by
405 CPUC. Until recently, the Commission’s interest in the area was primarily concerned with
406 vegetation management — ensuring that trees wouldn’t strike power lines, sparking fires.⁴⁴

407 However, as trees began dying *en masse* across the state in 2011 and 2012 from a
408 combination of drought and invasive bark beetles, CPUC took action. In January 2012, the
409 Commission issued orders requiring the Southern California electric utilities (including SCE
410 and SDG&E) to prepare fire prevention plans, as well as institute annual patrols and 5-year
411 detailed inspections of their electric systems. However, Northern California utilities —
412 including PG&E — were only required to conduct patrols and inspections half as frequently,

⁴² Gold, “Safety Is Not a Glamorous Thing.”

⁴³ CPUC Independent Review Panel, “Report of the Independent Review Panel: San Bruno Explosion,” 24.

⁴⁴ Blunt and Gold, “PG&E Delayed Safety Work on Power Line That Is Prime Suspect in California Wildfire.”

413 and the decision on whether or not to produce fire prevention plans was left up to their
414 judgement.⁴⁵ (PG&E ended up submitting a plan.)⁴⁶

415 In explaining their more lenient approach towards PG&E and Northern California
416 utilities, CPUC argued that “there is no history of catastrophic power-line fires in Northern
417 California, and Northern California does not experience Santa Ana windstorms that
418 contribute significantly to the risk of catastrophic power-line fires in Southern California.”
419 However, in the same order, the Commission also admitted that “the magnitude of the risk
420 of catastrophic wind-caused power-line fires occurring in Northern California is unknown at
421 this time.”⁴⁷

422 Eight years, and more than 18 catastrophic wind-caused power-line fires later, the
423 benefit of hindsight shows us how PG&E’s reactive, historically-driven approach to safety
424 regulation was a crucial turning point. Would PG&E have caught the weakened C-hook on
425 Tower 27:222 if it had been forced to conduct more frequent patrols and inspections? That’s
426 a counterfactual we cannot answer. However, it does appear that CPUC suffered the same
427 failure to proactively contend with the growing risks of wildfire in Northern California that
428 bedeviled PG&E.

429 Even so, the Commission deserves some credit for adapting as the situation worsened.
430 In January 2014, Governor Brown declared a state of emergency over the drought, and CPUC
431 ordered California’s electric utilities (this time, including PG&E) to “begin reporting the
432 number of fires started by their equipment.” It’s only because of this mandate that we were
433 able to calculate that PG&E was responsible for starting 1,986 fires between June 2014 and
434 the end of 2018.⁴⁸

435 In April of that year, federal criminal charges were filed against PG&E, which would
436 result in its 2016 conviction and placement on a five-year federal probation. CPUC added to
437 the federal action in April 2015, with its \$1.6 billion fine and forced ratepayer rebates

⁴⁵ Blunt, “PG&E: Wired to Fail.”

⁴⁶ Pacific Gas and Electric Company, “Fire Prevention Plan.”

⁴⁷ California Public Utilities Commission, “Decision 12-01-032: Adopting Regulations to Reduce Fire Hazards Associated with Overhead Power Lines and Communication Facilities.”

⁴⁸ Blunt, “PG&E: Wired to Fail.”

438 CPUC finally began an investigation of PG&E’s electric system safety in 2015, but as
439 of December 2019, the investigation remained ongoing. In the meantime, the 2017, 2018, and
440 2019 wildfire seasons came and went — and PG&E filed for bankruptcy.⁴⁹

441 Reporting suggests that CPUC has historically struggled to adequately support safety
442 inspections and investigations. While it more than tripled the size of its safety and
443 enforcement division in the wake of the San Bruno explosion, it still has problems hiring and
444 retaining qualified regulatory and engineering staff. The WSJ also found numerous apparent
445 instances of revolving door regulation and hints of regulatory capture, citing numerous
446 instances of apparently inappropriate contact/coordination between PG&E and CPUC staff
447 regarding safety and enforcement matters.⁵⁰

448 What do we make of CPUC’s halting performance? We find that the Commission’s
449 policy focus on climate change and clean energy, driven in no small part by escalating RPS
450 targets from Sacramento, played a role in pulling its focus from its safety mission. However,
451 we find that a far more significant driver of its safety missteps was its reactive safety posture,
452 which favored historical data and appears to have missed crucial opportunities to act based
453 on informed projections of growing climate risk. As a result, it — like PG&E — acted too
454 slowly to confront the growing wildfire risk in Northern California.

455 Neither CPUC nor PG&E were practicing anything that could be even remotely
456 considered planned adaptation — and the costs of their lack of foresight, or even a robust
457 attempt at foresight, were swift. The terrible destruction caused by the 2017 and 2018
458 wildfires can be quantified in many ways: the 147 lives tragically lost, the 30,500 structures
459 destroyed, the 3.5 million acres burned, the \$43.2 billion in damage costs. However, these
460 statistics leave out one of the most prominent casualties of the fires:

461 The Pacific Gas and Electric Company, itself.

462 By the end of 2018, PG&E was already facing 700 lawsuits resulting from the 2017
463 wine country fires. By January 2019, 50 more lawsuits (six seeking class-action status) as a
464 result of the Camp Fire had been added to that pile. Together, PG&E’s legal liabilities for the
465 two wildfire seasons were estimated to be more than \$30 billion. This rivaled the company’s
466 peak market capitalization of \$36.7 billion, reached in 2017, and was more than double the
467 \$12.3 billion valuation it fell to by the time the Camp Fire was contained at the end of

⁴⁹ Gold, “Safety Is Not a Glamorous Thing.”

⁵⁰ Gold.

468 November 2018.⁵¹ As the financial curtain began to descend on the company, the company's
469 CEO resigned at the request of PG&E's board on January 13th, after just 14 months on the
470 job.

471 The next morning, PG&E announce it intended to seek Chapter 11 bankruptcy
472 protection.

473 In the aftermath of the Camp Fire and PG&E's bankruptcy, the failure of both the
474 utility and its regulator to even attempt planned adaptation — leading to a terrible string of
475 fires and a veritable tsunami of legal liability — was noted with concern by California's state
476 legislature. In response, they devised a plan that sought to provide PG&E and the state's
477 other utilities a buffer of sorts against future wildfire liability risks, while imposing a certain
478 modicum of planned adaptation upon them in exchange.

479 In July of 2019, California's state legislature passed A.B. 1054, which included a
480 number of changes to the state's legal treatment of wildfire risks. Most notably, it created a
481 \$21 billion Wildfire Fund that is intended to help electric utilities deal with the costs of
482 wildfires caused by their equipment — the very same ones that sent PG&E into bankruptcy.
483 First introduced in February 2019, the legislation was passed just in time to avoid a
484 threatened July 2019 downgrade of the ratings of the state's other two major utilities,
485 Southern California Edison and San Diego Gas & Electric, by Standard and Poor's and other
486 rating agencies, which had already downgraded them in 2019, citing severe liability risks
487 from wildfires. While participation in the fund was offered to all California electric utilities,
488 only PG&E, SCE, and SDG&E elected to join.

489 The legislation gave the utilities two options for how the fund would be structured.
490 The first, known as the "liquidity option" offered the utilities what was essentially a \$10.5
491 billion revolving credit line — a lending facility that they could tap into in the event that they
492 faced mounting losses.

493 The lending facility would be funded by an annual charge collected from ratepayers.
494 In order to avoid actually raising electricity rates for consumers, the annual charge takes the
495 place of an existing charge that was set to expire in 2020. Known as the "DWR charge," it
496 raised funds from ratepayers to support the repayment of money the utilities owed

⁵¹ Blunt, "PG&E: Wired to Fail."

497 California’s Department of Water Resources, for helping pay for the costs of power during the
498 2000/2001 electricity crisis.⁵²

499 However, while the liquidity facility was capitalized using ratepayer money, the
500 utilities would be held responsible for paying back the money they were loaned for wildfire-
501 related expenses within six months: either by seeking CPUC’s approval to pass costs along
502 to ratepayers, or by having their shareholders foot the bill.⁵³

503 This structure raised a number of concerns among utilities. As the 2017 Witch Fire
504 case showed, however, CPUC has taken a fairly firm stance on the “just and reasonable”
505 standard for approving rate hikes as a result of utility-caused wildfires. Given this, there was
506 concern among the utilities that CPUC’s unwillingness to allow cost pass-through to
507 ratepayers might leave shareholders on the hook. In addition, there was concern that \$10.5
508 billion might not be enough to cover another truly catastrophic wildfire season — especially
509 ones like 2017 and 2018, which saw significant fires in both Northern and Southern
510 California.

511 As a result, SCE and SDG&E both opted into the second proposed structure, creating
512 the \$21 billion fund currently in existence.

513 The current structure has two major components: an initial payment of \$7.5 billion,
514 to be made by the end of 2019, and annual payments of \$902 million which continue through
515 2035. The costs of both the initial and annual payments are to be split among the utilities
516 using a “wildfire allocation metric” — essentially a fixed ratio, based on historical factors set
517 out by A.B. 1054 and CPUC, which assigns 64.2% of the costs to PG&E, 31.5% to SCE, and
518 4.3% to SDG&E.

519 The initial payments, to be funded by the utilities and their shareholders, were made
520 by SCE and SDG&E last year, while PG&E has been given until it exits bankruptcy to make
521 its initial payment.

522 The annual payments will be funded by a combination of shareholder and ratepayer
523 funds. CPUC authorized the utilities to impose an annual charge on ratepayers equivalent
524 to the aforementioned DWR charge, with the total funds raised by 2035 not to exceed \$10.5
525 billion, while also authorizing the issue of new debt to pay for the shareholder contribution.

⁵² California Public Utilities Commission, “Decision 19-10-056: Approving Imposition of a Non-Bypassable Charge to Support California’s Wildfire Fund and Adopting Rate Agreement Between the California Department of Water Resources and the California Public Utilities Commission.”

⁵³ A.B. 1054 - Public utilities: wildfires and employee protection, sec. 3291.

526 Altogether, the utilities and their shareholders will contribute \$10.5 billion to the
527 Wildfire Fund, with another \$10.5 billion raised from ratepayers. The utilities were also
528 required make a combined \$5 billion in wildfire safety investments, divided amongst the
529 them per the wildfire allocation metric, the costs of which could not be passed on to
530 shareholders.⁵⁴

531 In order to actually access money from the Fund to pay off liabilities stemming from
532 wildfires caused by their equipment, utilities will have to meet a number of conditions. First,
533 they must have made their initial contributions in a timely manner — which, for PG&E,
534 means that it must meet its target of exiting bankruptcy proceedings by the end of June 2020.
535 Second, the utility must absorb the first \$1 billion of wildfire-related liabilities (or the total
536 amount of its mandated wildfire insurance coverage, whichever is greater), before it can tap
537 into the Wildfire Fund.

538 It is the third criteria, however, which is of the greatest interest to us. In order to
539 access the Wildfire Fund, the utilities must receive an annual safety certification from CPUC,
540 based on a number of wildfire risk and organizational management criteria. This
541 requirement builds on legislation passed in the wake of the 2017 and 2018 fires, which
542 requires the major California electric utilities to submit detailed Wildfire Mitigation Plans
543 (WMPs) laying out the efforts they planned to take to build resilience against wildfire risk.
544 The first round of WMPs were submitted in 2019, and the 2020 WMPs were conditionally
545 approved by CPUC on May 7, 2020, pending a formal June 11th vote of the full commission.⁵⁵
546 As set forth by law, the new certification process requires both the utilities and CPUC to
547 make a thorough review of the utility’s WMP for the preceding year and its effectiveness, any
548 changes to the wildfire risks face by the utility, and its proposed WMP for the coming year
549 — with CPUC free to insist on modifications, as it sees necessary. Under this process, all
550 three utilities have successfully obtained their 2019-2020 safety certifications.⁵⁶⁵⁷⁵⁸

⁵⁴ A.B. 1054 - Public utilities: wildfires and employee protection, sec. 8386.3.

⁵⁵ California Public Utilities Commission, “CPUC Wildfire Safety Division Recommends Approving Utility 2020 Wildfire Mitigation Plans with Conditions.”

⁵⁶ California Public Utilities Commission, “Initial Safety Certification for Pacific Gas and Electric Company,” August 23, 2019.

⁵⁷ California Public Utilities Commission, “Initial Safety Certification for Southern California Edison Company,” July 25, 2019.

⁵⁸ California Public Utilities Commission, “Initial Safety Certification for San Diego Gas and Electric,” July 26, 2019.

551 The impact of California’s novel plan seems to have reaped immediate benefits, as
552 exhibited by the 2019 wildfire season — the first under the new system. While California saw
553 7,860 wildfires break out from January to November, the impacts of those fires were far
554 milder. While 1,548,429 acres were burned in 2017 and 1,963,101 acres in 2018, only 259,823
555 acres were consumed in 2019. Similarly, while 10,280 and 24,226 structures were destroyed
556 in 2017 and 2018, respectively, 2019 saw the loss of a mere 732. And, most heartening, while
557 47 lives were lost to wildfires in 2017 and 85 in 2018, 2019 claimed only three. And though
558 the failure of a 230 kV PG&E transmission line in Sonoma County has been tentatively
559 implicated in the 77,758-acre Kincade Fire (the CPUC/CAL FIRE investigation remains in
560 progress), not a single 2019 wildfire cracked the lists of California’s top 20 largest or
561 deadliest. Compared to the preceding two years, the 2019 California fire season appears to
562 have been a significant reprieve.

563 This was no accident, but rather the response of proactive measures that PG&E was
564 driven to take by the new system. For the first time, the utility began a widespread campaign
565 of proactively shutting of power to particularly vulnerable areas during periods of high
566 wildfire risk. In disclosures to CPUC, PG&E disclosed that in the wake of the shutoff events,
567 it had identified a total of 720 hazards or instances of damage that could have potentially
568 sparked wildfires — 554 of which occurred during just two shutoffs in October 2019.
569 Moreover, PG&E disclosed that over the course of the October shutoff events, it identified
570 274 instances of damage to its power lines and other equipment by high winds and vegetation,
571 each of which would likely have produced an electrical arc event capable of starting a fire.^{59,60}

572 The progress made by A.B. 1054 is a remarkable step. In exchange for giving the
573 utilities a financial backstop against wildfire risks, the state of California was able to replace
574 CPUC’s previously ineffectual, reactive wildfire risk regulatory regime with a structured,
575 proactive process. Now, instead of waiting half a decade for CPUC to finish a single
576 investigation, both utilities and the Commission must take part in a structured, annual
577 process that ensures that the lessons of preceding years are being adequately incorporated
578 into current risk management efforts, while also ensuring that future risks are being properly
579 surfaced.

⁵⁹ Pacific Gas and Electric Company, “Response to Request for Information on PSPS.”

⁶⁰ Pacific Gas and Electric Company, “Response to Questions to PG&E Re: Late October PSPSs.”

580 **Superstorm Sandy**

581

582 Having examined the body blow sustained by Puerto Rico after Hurricane Maria, and
583 the ongoing effort to combat Northern California’s wildfires, we now turn our attention to the
584 oldest of our case studies: a “Superstorm” that landed a powerful “left hook” across the
585 nation’s largest metropolitan area — and in the process, appears to have served as a wake-
586 up call that not only led to a remarkable focus on building resilience into the region’s electric
587 systems, but served as the foundation of a major push for resilient decarbonization.

588 When it made landfall on the Jersey Shore and sent a storm surge up Wall Street in
589 late October 2012, Superstorm Sandy became a turning point for the New York/New Jersey
590 region.

591 The storm was devastating, there’s no doubt about it. Sandy claimed 157 lives in the
592 United States. It caused \$65 billion in damage across the East Coast, including roughly \$32
593 billion in New Jersey and \$30 billion in New York State — with around \$19 billion of that in
594 New York City alone.

595 And at its peak, it left 8 million people without electricity, including 4.6 million in
596 New York and New Jersey — some of whom wouldn’t get their power back for nearly two
597 weeks. But with the help of a massive mutual assistance effort from across the U.S., the
598 region’s utilities restored service faster than average. And with the help of more than \$50
599 billion in federal funding, the region — and its electric systems — began to rebuild.

600 What interests us most about Sandy isn’t the damage it did to electric systems, but
601 rather the key lesson that utilities, regulators, and state governments took away in its
602 aftermath: this is a preview of a future that can’t merely be dealt with reactively but rather
603 must be met with proactive planning and regular assessment. The aftermath of the storm
604 saw a remarkable string of utility investments, regulatory precedent, and governmental
605 policies that offer one example of what a disaster-catalyzed push for planned adaptation can
606 look like.

607 The toll Superstorm Sandy exacted on the East Coast was immense. Across states, it
608 claimed a total of 157 lives. In New Jersey, over 360,000 homes and 19,000 businesses were
609 damaged or destroyed, with damage particularly severe along the Jersey Shore and the
610 state’s barrier islands. Along the Hudson, the storm surge flooded Jersey City and rendered
611 half of the city of Hoboken impassable, requiring the deployment of the National Guard to
612 rescue nearly 20,000 residents trapped by the rising floodwaters. In New York, an estimated

613 305,000 homes were destroyed by the storm surge, with entire blocks of homes on Staten
614 Island and Long Island washed away.⁶¹ The storm also caused \$4.8 billion in damage to New
615 York City’s subway system.⁶²

616 Since it was technically no longer a tropical hurricane when it hit the New York/New
617 Jersey area, Sandy was quickly renamed by the press and the public. Its movie-monster-like
618 combination of a hurricane-force storm, an Atlantic high, a continental winter storm, and a
619 perfect high tide — as well as its proximity to the Halloween holiday — led a number of media
620 outlets to dub it the “Frankenstorm.”

621 But the nickname that has stuck is one that best captures the enormous impact it had
622 on the region: *Superstorm Sandy*.

623 Superstorm Sandy also dealt a significant blow to the region’s electric systems, leaving
624 8 million people across the East Coast without electricity in its immediate aftermath. This
625 included over 2.6 million customers in New Jersey (65% of the state) and nearly 2.1 million
626 people in New York (23% of the state).

627 Though local utilities made substantial efforts to protect their electric systems, in
628 advance of the storm, the combination of the record 14.1-foot storm surge, coastal flooding,
629 and high winds caught them by surprised and proved overwhelming. Local utility
630 Consolidated Edison (better known as ConEd), which serves much of New York City and the
631 surrounding counties, preemptively decided to shut down selected underground transmission
632 and distribution networks in Manhattan and Brooklyn, in an effort “to avoid serious damage
633 to equipment”— a practice it began in the 1990s, after a storm surge destroyed equipment
634 that remained energized.⁶³ Other utilities across the region did the same, hoping that these
635 efforts would also help speed the eventual restoration of power.⁶⁴

636 However, ConEd’s planning envisioned a maximum 12-foot storm surge, based in part
637 on a historical record set in 1821 — as did the preparations conducted by the Public Service
638 Electricity and Gas Company (PSE&G), the largest electric utility in New Jersey.^{65,66}

⁶¹ Blake et al., “Tropical Cyclone Report: Hurricane Sandy,” 18.

⁶² Hinds, “Totaling Sandy Losses.”

⁶³ Lacey, “RESILIENCY: How Superstorm Sandy Changed America’s Grid,” 19.

⁶⁴ North American Electric Reliability Corporation, “Hurricane Sandy Event Analysis Report,” 5.

⁶⁵ Van Nostrand, “Keeping the Lights on during Superstorm Sandy,” 101.

⁶⁶ Lacey, “RESILIENCY: How Superstorm Sandy Changed America’s Grid,” 27.

639 As a result, many utilities were caught off guard by Sandy’s 14.1-foot storm surge and
640 the high winds that accompanied it. ConEd left a key substation on 13th Street in lower
641 Manhattan — which powered the bottom third of the island — energized as the storm rolled
642 in, hoping to minimize the disruption of service to some of its most high-profile customers.
643 However, the flood barriers surrounding the substation only rose 12 feet above the water
644 level, and when the storm surge rolled in from the Battery, the substation failed with “the
645 blinding flash of an explosion,” plunging America’s “most famous skyline” into darkness.⁶⁷⁶⁸

646 ConEd’s surprise at the storm’s devastating impact was palpable in an after-action
647 report it submitted to NERC, noting that “The toll the storm took on our electric systems was
648 astounding.” The damage was significant, with the storm surge, wind, and flooding
649 destroying five transmission substations, 4 GW of generation, over 900 transformers, and
650 1000 distribution poles. Altogether, the storm knocked 70% of ConEd’s overhead distribution
651 system offline, as well as more than fifteen of its transmission and distribution networks
652 across Manhattan, Brooklyn, and Staten Island.⁶⁹ Altogether, “about one-third of Con
653 Edison's customers — 1,115,000 out of 3.3 million — lost power.”⁷⁰

654 Elsewhere in New York, Long Island Power Authority (LIPA), a publicly-owned utility
655 operated by the investor-owned utility National Grid, saw 1.1 million (nearly 90%) of its Long
656 Island customers lose power.⁷¹ LIPA, which would be near-universally criticized for
657 insufficient preparation and mismanaged recovery efforts, “experienced damage to 50
658 substations, 2,100 transformers, and 4,500 utility poles following Sandy.”⁷² Within a year,
659 New York Governor Andrew Cuomo would strip control of LIPA from National Grid, on the
660 basis of its poor handling of Sandy, and award it to PSE&G — a radical proposal, made in an
661 effort to shock the utility into cleaning up its act, and followed through upon with the hope
662 of helping LIPA turn over a new leaf.⁷³

663 The damage was equally severe in New Jersey, where 90% of PSE&G’s customers lost
664 power as the utility experienced damage to 31 substations and 1,000 transformers. Jersey

⁶⁷ Lacey, 19.

⁶⁸ Van Nostrand, “Keeping the Lights on during Superstorm Sandy,” 101.

⁶⁹ North American Electric Reliability Corporation, “Hurricane Sandy Event Analysis Report,” 13.

⁷⁰ Van Nostrand, “Keeping the Lights on during Superstorm Sandy,” 101.

⁷¹ Van Nostrand, 102.

⁷² Office of Electricity Delivery and Energy Reliability, “Comparing the Impacts of Northeast Hurricanes on Energy Infrastructure,” 14.

⁷³ Katherine Tweed, “PSE&G Takes Over LIPA Operations.”

665 Central Power and Light (JCP&L), the state’s second-largest utility, also experienced severe
666 outages following the loss of 3,400 sections of wire — and, like LIPA, would be roundly
667 criticized for a slow, ineffective response and failing to communicate adequately with
668 customers and local municipalities.⁷⁴

669 A number of the utilities had already invested in vegetation management and the
670 replacement of older transmission and distribution lines, in the wake of Hurricane Irene —
671 which made landfall in the region as a tropical storm in August 2011, but still managed to
672 cut power to around 4 million people. However, Sandy — a much stronger storm — had much
673 more significant impacts on electric systems, with PG&E, and LIPA reporting that it caused
674 roughly double the physical damage of Irene, and ConEd noting that it “lost 10 times as many
675 poles, more than five times as many transformers, and more than four times as many miles
676 of cable.” Nevertheless, it still damaged some of the same equipment that had been repaired
677 after Irene, which remained insufficiently protected against flooding and storm surges.⁷⁵⁷⁶⁷⁷

678 The recovery of the region’s electric systems from Superstorm Sandy took roughly
679 twice as long as their recovery from Hurricane Irene. After Irene, 95% of customers had their
680 power restored within about 5 days, as seen in Figure 16, while it took roughly 10 days to
681 reach that level after Sandy. Restoration times varied by location, as seen in Figure 15: New
682 Jersey reached 95% restoration within 10 days, while New York as a whole only took a week.
683 However, parts of Long Island (including much of LIPA’s service area) took 12-14 days to
684 reach that level.

685 The restoration process was significantly aided by 67,000 workers from around 100
686 companies, who traveled to the region from 34 states, as well as Canada.⁷⁸⁷⁹ However, as is
687 evident in both Figure 15 and Figure 16, the progress of the restoration efforts was hindered
688 by a Nor’easter which covered the region in snow and ice, just over a week after Sandy made
689 landfall — increasing the number of outages (including by cutting power to some customers

⁷⁴ Office of Electricity Delivery and Energy Reliability, “Comparing the Impacts of Northeast Hurricanes on Energy Infrastructure,” 9–10.

⁷⁵ Office of Electricity Delivery and Energy Reliability, 13–14.

⁷⁶ Van Nostrand, “Keeping the Lights on during Superstorm Sandy,” 102.

⁷⁷ Lacey, “RESILIENCY: How Superstorm Sandy Changed America’s Grid,” 6,14, 28.

⁷⁸ North American Electric Reliability Corporation, “Hurricane Sandy Event Analysis Report,” 20.

⁷⁹ Office of Electricity Delivery and Energy Reliability, “Comparing the Impacts of Northeast Hurricanes on Energy Infrastructure,” 19.

690 who'd just had it restored to them), and slowing the progress of utility crews trying to restore
691 power.

692 But even in the face of this follow-on disruption, electric power was almost fully
693 restored across New York and New Jersey within two weeks — with the exception of the
694 hundreds of thousands of homes that had been washed away by the storm.

695 Unlike in the wake of Hurricane Maria, where merely restoring power to 95% of
696 Puerto Rico's residents took nearly half a year, the two-week restoration that followed
697 Superstorm Sandy to quickly pivot to the challenge of addressing the long-term threats posed
698 by climate change, extreme weather, and the threat of another Sandy-caliber storm. In the
699 face of the damage wrought by the storm, the utilities' tragically low-balled estimates of their
700 ability to deal with its impacts — based largely on outdated historical data — became a focal
701 point for efforts to reform the way extreme weather risks were incorporated into electric
702 system planning across the region.

703 The most notable example of this occurred in New York, where ConEd, its regulator,
704 the New York State Public Service Commission (PSC), and a group of determined NGOs set
705 a remarkable precedent for how an ordinary electric regulatory process — the rate case —
706 could become a powerful instrument of planned adaptation. In January 2013, ConEd
707 submitted a filing for its annual general electric, natural gas, and steam rate case that
708 proposed “approximately \$1 billion in potential storm hardening structural improvements”
709 to be carried out through 2017, with a commitment to spend a quarter of the funds on “storm
710 protection measures” by the end of 2015. Of the \$1 billion total, \$800 million was allocated to
711 its electric system.

712 The storm hardening/protection measures would be “intended to reduce the size and
713 scope of service outages from major storms, as well as to improve responsiveness and expedite
714 the recovery process to better serve [ConEd's] customers,” and specifically included “strategic
715 undergrounding and flood protection projects,” including flood walls, elevating equipment,
716 and installing submersible equipment.

717 At the same time, ConEd also proposed “various projects to improve the flexibility of
718 the electric distribution system,” specifically referencing the installation of additional
719 switches, “smart grid technology,” and the “reconfiguration” of parts of its electrical system
720 to “reduce the impact to customers most affected by certain storms.”

721 After ConEd submitted its filing, a group of environmental NGOs joined the rate case
722 as intervenors, seeking to offer “a different perspective” on how the ratemaking process could

723 help shape ConEd’s electric system to be “resilient under conditions that are likely to exist
724 for the next thirty or forty years.” They wanted to ensure that ConEd’s plans for the future
725 not only incorporated the risks that it had come to realize in the wake of Sandy, but would
726 also contain a mechanism to reevaluate the risks — and their impact on its system planning
727 — as they evolved over time.

728 Chief among the intervenors’ concerns was the fact that the plan ConEd had set forth
729 in its 2013 filing didn’t take into account the growing climate risks that the utility would
730 have to contend with in the coming decades, with no mechanism for review as the risks
731 changed, or for learning from experience. The plan also failed to comprehensively consider
732 the impacts that climate risks would have on the infrastructure that ConEd was proposing
733 to build, over its expected multi-decadal lifespan. Additionally, the intervenors argued that
734 ConEd’s approach to “storm hardening” was a myopic perspective that neglected much of the
735 value that could be realized from resilience-based approaches, including distributed energy
736 resources and microgrids — relatively novel technologies whose value would only become
737 clear through periodic reviews of their performance.

738 In a remarkable turn of events, both the PSC and ConEd found the intervenors’
739 arguments to be quite persuasive. Just over a year later, the PSC issued a final order in
740 ConEd’s rate case that has since become the gold standard for driving planned adaptation for
741 climate risk through ratemaking proceedings.

742 There were three novel components to the PSC’s order. First, it noted that ConEd and
743 the NGO intervenors had formed a “Storm Hardening and Resiliency Collaborative,” aimed
744 at examining a broader set of resilience-based options to protect ConEd’s electric system from
745 future Sandy caliber storms. In approving ConEd’s \$1 billion investment over four years, the
746 PSC explicitly ordered the utility to work in tandem with the Collaborative to ensure that it
747 was “assess[ing] the relative benefits and costs of resilience of existing utility infrastructure
748 and alternative resilience approaches,” with a specific order to consider expanding its use of
749 microgrids and distributed energy resources. As part of the order, ConEd was expected to
750 conduct a comprehensive review of its system planning each year, working in tandem with
751 the Collaborative, and use that review to inform the plans for its electric system that it would
752 submit for review and approval that it would submit to the PSC each year.

753 Second, while setting a new standard for resilience, the PSC also broke new ground
754 in regulatorily mandated planned adaptation for climate risk. The Commission rooted its
755 action in an acknowledgement that “Sandy drove home the urgency not only of emergency

756 preparedness, but of advance planning for the impacts on the utilities of New York State of
757 extreme weather events exacerbated by a changing climate.” It further noted that “changing
758 climate conditions are likely to affect Con Edison’s ability to provide reliable service without
759 major disruptions.” As a result, the PSC ordered ConEd to consider the “risks and
760 probabilities of future climate events” in all of its future investment decisions — and to
761 periodically reevaluate its risk assessments, in tandem with its rate cases, and incorporate
762 the updated assessments into its annual plans. Additionally, the PSC ordered the utility to
763 produce a series of comprehensive assessments of its electric system’s short and long-term
764 vulnerability to climate risks and impacts, to culminate in an implementation plan to address
765 the vulnerabilities. The implementation plan would become another part of the ConEd’s
766 annual rate case, with the PSC reviewing both ConEd’s performance against the plan, and
767 the continued validity of the assumptions in the plan itself.

768 And third, the PSC applied its new standards for planned adaptation to all utilities in
769 the state of New York, insisting that “We expect the utilities to consult the most current data
770 to evaluate the climate impacts anticipated in their regions over the next years and decades,
771 and to integrate these considerations into their system planning and construction forecasts
772 and budgets.” These utilities would, as a result, become subject to the same kinds of reviews
773 in their annual rate cases.

774 In one fell swoop, the Commission created a powerful new planned adaptation
775 structure to ensure that ConEd was appropriately incorporating past lessons and future
776 insights into all of its capital investments, established a requirement that ConEd incorporate
777 consideration of future climate risks, with periodic reevaluation, into all of its future decision
778 making, and then applied those same standards to every utility in the state of New York.

779 In other words, it created a regulatory mandate for planned adaptation as a climate
780 risk management strategy.

781 The importance of this decision cannot be overstated. In a first for a regulatory body
782 of its scope and powers, the Commission recognized that investments in future electric
783 systems in the face of climate risks and impacts needed to be judged through a process that
784 was proactive, required both hindsight and foresight assessments, and offered the
785 opportunity for regular review. Using the usually mundane regulatory process of setting
786 rates for electric service, the PSC managed to create a robust process for driving resilient
787 decarbonization.

788 Looking beyond New York, Gundlach (2020) argues that the ConEd rate case will
789 prove to be an important precedent for those looking to push regulators to impose similar
790 planned adaptation requirements for climate risk on electric utilities. After all, New York is
791 far from unique in facing climate risk. In the years to come, we should expect to see the PSC's
792 2014 order serve as a template for other states looking to implement planned adaptation
793 processes to help protect their electric power systems.

794 **Lessons for planned adaptation**

795

796 The three cases we examined here offer three very different examples of how efforts
797 to implement planned adaptation efforts in the wake of an extreme weather disaster can play
798 out.

799 In Puerto Rico, we saw that while the legislature imposed a nominal planned
800 adaptation mechanism for PREPA’s electric system in the form of the IRP process, this
801 system simply could not contend with the scale of the challenges that PREPA and the
802 commonwealth were facing. The blow from Hurricane Maria, coming on top of the island’s
803 existing financial and socioeconomic distress, meant that even when presented with a
804 framework for review, reconsideration, and informed design of its plans for the future of its
805 electric system, PREPA was simply too overwhelmed to fully make use of the opportunity.
806 Instead, while it used the IRP process to take a stab at implementing the lessons of Maria,
807 its plans remained, by and large, rooted in its legacy of financial constraints.

808 In California, we saw a more optimistic sign. In the aftermath of a legacy of reactive,
809 lagging wildfire risk management efforts by both PG&E and CPUC, the state legislature
810 stepped in to offer a more robust alternative, rooted in planned adaptation. In exchange for
811 providing the utilities with a buffer against future wildfire liabilities, the state required them
812 to submit to a rigorous wildfire planning and safety certification process. To incentivize them
813 to take the effort seriously, the state made the utilities’ ability to draw on the Wildfire Fund
814 in times on need contingent on their successfully completing this annual review each year.

815 And in New York, we saw how the shock of Superstorm Sandy catalyzed a whole new
816 regulatory regime for incorporating future climate risks into long-term electric system
817 planning — one rooted in planned adaptation. Not only does the PSC’s 2014 order require
818 ConEd to conduct a stakeholder-informed annual review of its proposals for the future of its
819 electric system, but it also imposed a series of requirements for in-depth assessments of
820 climate risk to be incorporated into that review process. And, in a sweeping move that experts
821 believe could serve as a national precedent, the PSC then applied these novel planned
822 adaptation requirements to every utility in New York.

823 We can draw a number of key lessons from these examples. Puerto Rico and
824 California’s experiences with planned adaptation show us that merely imposing the
825 requirement that plans and rules be reviewed and updated periodically isn’t enough to
826 actually drive proactive progress. In the aftermath of Hurricane Maria, the IRP process was

827 met by PREPA with the regulatory equivalent of an exhausted shrug — an attempt to
828 implement lessons learned, but a recognition that the broader challenges it faced limited the
829 ambition of what lessons it could actually hope to implement. By contrast, California’s carrot-
830 and-stick approach to planned adaptation appears much more compelling, especially in light
831 of the remarkable success PG&E experienced in the relative mildness of the 2019 wildfire
832 season.

833 California’s approach succeeded where Puerto Rico’s did not for two key reasons. First,
834 it didn’t merely impose a mandate the plan and adapt, but also provided some support for it
835 — in the form of a novel Wildfire Fund that gave PG&E the guarantee of financial safety it
836 needed to turn its attention to the deeper system improvements it needed to make. And
837 second, it made the planned adaptation process an integral part of the way the electric system
838 was operated, by ensuring that the utilities would not be able to access the Wildfire Fund
839 unless they successfully completed the WMP and safety certification processes to the
840 satisfaction of regulators.

841 In the wake of the fires, a number of arguments have been made for divorcing the
842 planned adaptation/wildfire mitigation system created under A.B. 1054 from the broader
843 project of regulatory oversight of electric system planning — both are currently handled by
844 CPUC.⁸⁰ Critics of the current approach argue that, given CPUC’s checkered history of
845 overseeing PG&E and legacy of troubles with prioritization, it lacks the capacity to conduct
846 effective oversight of the utility’s planned adaptation efforts for wildfire risk. Our
847 examination of the case tentatively supports this idea — the historical record certainly
848 suggests that an independent safety monitor would be a far more credible overseer of
849 PG&E’s planned adaptation process than CPUC. However, any such monitor must be able to
850 retain the control over both PG&E’s future investments and immediate access to the Wildfire
851 Fund that CPUC currently holds. Otherwise, it risks leaving the planned adaptation process
852 without any leverage — essentially as toothless as Puerto Rico’s IRP process.

853 This is a lesson underscored by the actions of the New York PSC, which was able to
854 use its power over the annual ratemaking process — which regulated utilities are dependent
855 on for all of their revenue — to impose an ambitious, far-reaching planned adaptation process
856 on not only ConEd, but every utility in the state of New York.

⁸⁰ Gold, “Five Ways to Fix PG&E.”

857 Taken together, these lessons show us that planned adaptation efforts often play a
858 significant role in the way electric system regulators respond to catastrophic extreme
859 weather events. However, the success of these efforts depends on being cognizant of the full
860 range of stresses that utilities are under, and effectively leveraging regulatory powers to
861 ensure that utilities have the appropriate support and incentives needed to drive an effective
862 utilization of the planned adaptation process.

863

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