NATIONAL SECURITY, TECHNOLOGY, AND LAW

Climate Change Impacts on Subsea Cables and Ramifications for National Security—A Legal Perspective

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INTRODUCTION

While there is much debate about the role of energy-intensive internet infrastructure in accelerating climate change, the impact of climate change on internet infrastructure has not been given due attention. This article considers how climate change impacts a critical element of internet infrastructure—the subsea cable system—and analyzes the legal and policy factors that inform the protection of this system.[1]

Data centers and mobile towers are more often the visible face of internet infrastructure. However, submarine cables are information-carrying arteries snaking across the deep oceans of the world, inconspicuously transmitting millions of terabytes of data in seconds.[2] Since these cables and the data transmitted over them are vital to many aspects of human affairs, protecting the integrity of the cables is critical to the United States' national security and prosperity.[3] While there has been robust discussion about the need for additional policy and legal responses to possible intentional disruption to cables by malicious actors, much less attention has been given to protection of the subsea cable infrastructure from unintentional, natural hazards.

Compared to anchoring and fishing, natural hazards have been a less frequent and yet increasingly concerning threat that has already had widespread network impacts.[4] Their impact became evident most recently in an internet blackout in Tonga on January 15, 2022, caused by a volcanic eruption and earthquake that severed the nation's only cable connection.[5] In 2012, Hurricane Sandy slammed into the United States' East Coast, causing an estimated $71 billion in damage and knocking out several key exchanges where undersea cables linked North America and Europe.[6]

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In the United States, existing legal mechanisms help alleviate the impacts of climate change (in certain instances purposefully but in others inadvertently). But most rules that govern cable systems have been created without considering the challenges that climate change might pose. Moreover, some of these rules apply only to new cable systems, leaving the existing ones unattended. To be sure, the cable industry has sought to strengthen the system against climate change. However, the private sector does not provide a comprehensive solution. State and federal governments must play a greater role, this paper argues, in ensuring that undersea cables are protected against the incremental impacts of climate change.

LITERATURE REVIEW

Current studies on the impact of climate change on internet infrastructure mainly focus on other components of the information and communication technology (ICT) sector, namely data centers. To date, there have been only three relevant attempts to investigate the effects of climate change on subsea cables.

First, the report *Lights Out: Climate Change Risk to Internet Infrastructure* (the "Lights Out Report"), an output of a 2018 study by Ramakrishnan Durairajan, Carol Barford, and Paul Barford, demonstrated that "climate change–related sea level incursions could have a devastating impact on internet communication infrastructure even in the relatively short term."[7] Based on the results of their study, the authors determined that in the next fifteen years, 1,186 miles of long-haul fiber conduit and 2,429 miles of metro fiber conduit will be underwater and 1,101 termination points will be surrounded by seawater.[8] The study submits that mitigating climate change–related risks will require a number of different strategies, some of which include developing frameworks to analyze the impact of physical countermeasures such as seawalls and hardened enclosures for subsea cable landing points.[9]

Second, the United Kingdom's National Oceanography Centre initiated a project, Climate Change and Global Telecoms ("UK NOC's project"), adopting a multidisciplinary approach to provide urgently needed evidence for decision makers to respond to climate change, including a white paper summarizing guidance for cable routing/design to adapt to climate change scenarios.[10] The research culminated in the peer-reviewed paper, "Climate Change Hotspots and Implications for the Global Subsea Telecommunications Network," which for the first time assesses how and where future climate change is likely to impact subsea cables and their shore-based infrastructure.[11]

The third piece of relevant literature is a September 2022 report by the Congressional Research Service, *Undersea Telecommunication Cables: Technology Overview and Issues for Congress* ("the CRS report").[12] This report discusses the technology of undersea telecommunication cables, threats to cables, US government actions to protect cables, and issues for congressional consideration. The report only briefly touches upon natural threats.[13]

A close review of these studies reveals a gap in addressing the problem of climate change on subsea cable systems via adequate policy measures. The CRS report suggests measures to enhance the regulatory regime around cable protection, but its proposals largely pertain to risks caused by intentional damage to the cable system and not harm due to natural events.[14] This is the area where our paper aims to contribute to the literature and to identify gaps in the law that, in the wake of climate change, could jeopardize national security.

ROLE OF CLIMATE CHANGE IN CABLE DAMAGE

Peer-reviewed science shows that the global climate has been and will likely continue warming at an unprecedented rate due to human-induced greenhouse gas (GHG) emissions.[15] Oceans experience the effects of climate change most acutely, as they take up more than 90 percent of all the Earth's excess heat.[16] The International Cable Protection Committee (ICPC) has compiled evidence that climate change will affect submarine cables both directly and indirectly as it reshapes human patterns of existence.[17] Therefore, climate change and its shifting weather patterns will intensify threats from both natural disasters and human-related causes.

In this section, we document how the increase in climate change–related events is relevant to the subsea cable system and the way that this may ultimately jeopardize national interests. There are two facets to this problem: (1) the vulnerability of the subsea cables (under the sea), and (2) the susceptibility of coastal infrastructure (on land) to climate change. A cable landing station may appear to be like any other industrial building, but on the inside, it is a critical point where buried cables, after traveling miles across oceans, terminate. Although some cable landing stations are hardened to even withstand a nuclear attack, most others are not. A single force majeure event may affect either or both facets of the infrastructure.

Interruptions in the ability to communicate or access information acutely upset the economy. During disasters, this inability puts national and human security and business value at risk.[18] Subsea cables also serve as lines of emergency preparedness communication at the time of natural disasters or other unforeseen circumstances. Hence, they constitute the very medium of emergency communication that, if disabled, will adversely affect the lives and economy of the nation.

One of the reasons climate change may have a widespread effect on the communications sector is that the resultant hazards may cause damage over a large area, affecting more than one cable network in a single event. Cable landfalls (points where cables terminate) are typically determined by geography. Both environmental and geopolitical considerations typically favor the landing of subsea cables in a narrow set of specific, preferred locations along a country's coastline.[19] Due to this factor, most cable systems are concentrated on certain points of the coast and a natural hazard may affect more than one subsea cable system at a time.[20] This aggravates the problem as the option of diverting traffic through other, redundant lines becomes limited. Cascading failure is yet another risk, where the collapse of one part of the network pulls down otherwise healthy sections overworked by the increased traffic load.[21]

The risk of damage to equipment and cables in the cable landing station is underpinned by the fact that many of these assets are designed to function within specific climate and environmental conditions and are not adaptable to an environment surrounded by or under water.[22] Hence, flooding due to sea level rise may severely impair the operating parameters of the coastal facilities, rendering them unfit for internet transmissions.

Climate change, which may lead to both increased weather variability and extreme events, may threaten the infrastructural integrity and productivity of this critical sector, potentially increasing the number and severity of disruptions.[23] Extreme or abnormal weather can lead to cascading impacts felt across sectors and borders. However, despite the importance of these sectors, the climate risk they face is poorly understood.[24] The following section describes the various climate change–related events that may potentially affect the subsea cable network.

POTENTIAL CLIMATE CHANGE–RELATED EVENTS

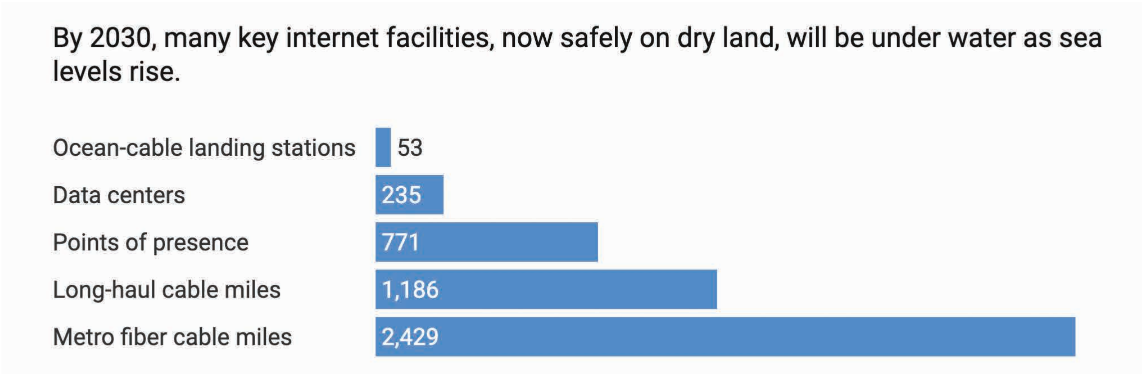
SEA LEVEL RISE AND COASTAL FLOODING

As the National Oceanic and Atmospheric Administration (NOAA) notes, "Even a small vertical rise can result in seawater covering large areas of flat beaches and low-lying land."[25] If sea level rises quickly, which is not a distant occurrence as underscored by the Lights Out Report, the encroaching ocean can drown coastal infrastructure, including the cable landing stations. As the report observes, "Higher seas also enable storm surges to travel farther inland, putting more lives in danger and increasing the risk to property when powerful storms come ashore."[26]

According to reporting, "Based on the assumption that global greenhouse gas emission trends will continue in their current relationship to human population and economic activity, that model expects global average sea levels to rise one foot by 2030, and a further five feet by 2100."[27] A more recent report by NOAA showcases an "even higher 'extreme' scenario, which takes into account the increasing evidence of more rapid melting in Greenland and Antarctic glaciers."[28] The Lights Out Report signifies the vulnerability of ocean cable landing stations to future sea level rise, as seen in figure 1.

Past events are evidence that natural hazards are increasing in number and intensity. Storm surges in 2012 in New York, tropical cyclones offshore from Taiwan in 2009, and extreme river flooding across West Africa in 2020 brought internet connectivity to a standstill in these areas.[29] Hurricane Irma blew across Florida in 2017, reportedly leaving many people without internet for over a week.[30] The risk to cable infrastructure

FIGURE 1 Subsumed by rising oceans



Source: Reproduced from Carol Barford, "Key Internet Connections and Locations at Risk from Rising Seas," *The Conversation*, September 7, 2018, based on the Lights Out Report, https://theconversation.com/key-internet-connections-and-locations-at-risk-from-rising-seas-101167. Used under CC BY-ND.

is likely to intensify and impact new locations, thus creating previously unforeseen hazards.[31]

The ICPC's "Submarine Cable Protection and the Environment" bulletin notes that "increased storminess under continued or more intense El Niño-La Niña events and other climatic cycles means that regions in the Pacific will become more exposed to onshore flooding, higher river discharge and underwater landslides that can break cables or threaten their terrestrial infrastructure."[32] The cable wires in the landing stations and other supporting facilities are mounted inside plastic pipes. When flooded, "the water could freeze and thaw, damaging or even breaking the wires."[33] It can also "corrode electronics and interrupt fiber optic signals."[34] This is because the underground cables are merely water resistant and not waterproof like subsea cables, with their "tough steel housings and rubber cladding."[35]

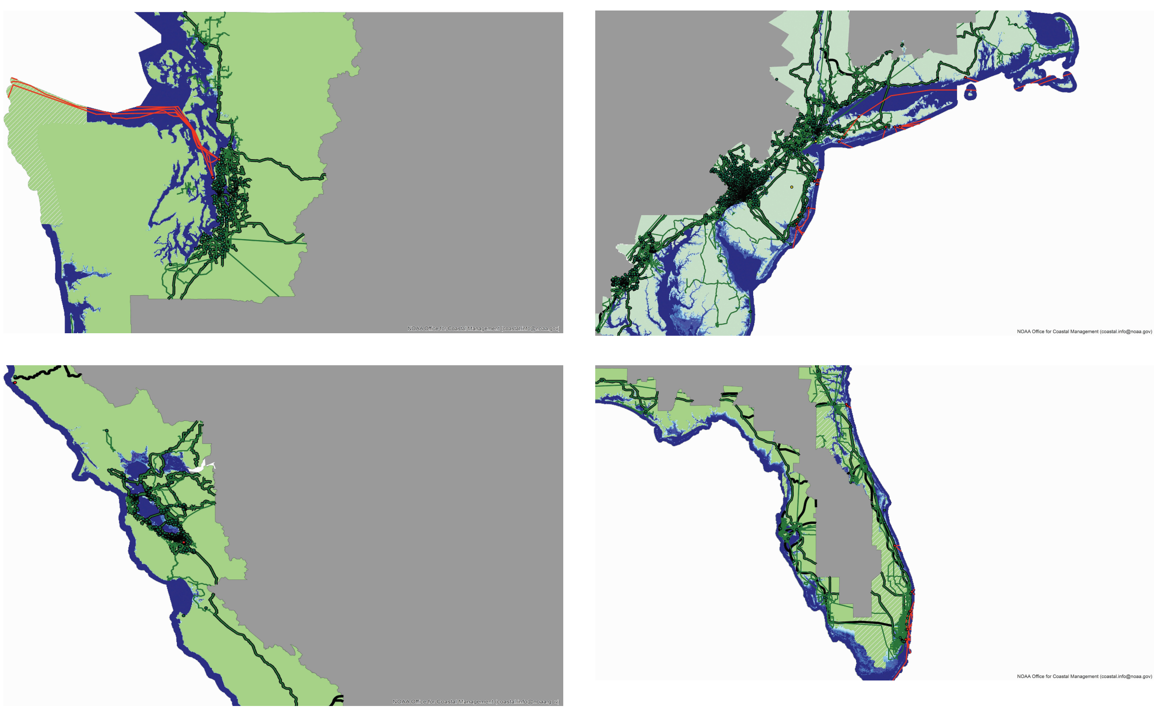
According to the Lights Out Report, New York, Miami, and Seattle are the most susceptible US cities (see figure 2). But given the way the internet works, the effects will not be contained to just those areas, as any data connections ferried through affected regions could be impacted (see figure 3).[36]

In practice, "in certain locations where terrestrial cabling will be submerged for long periods or consistently exposed, such as beaches or in subways," submarine underwater cabling design is employed.[37] However, this might not be the case for all twenty- to thirty-year-old cable systems. Verizon states that after Hurricane Sandy, it has replaced significant amounts of copper with fiber, as the former is vulnerable to water while the latter is not.[38] It is noteworthy that the hurricane did not damage cable landing stations themselves during this event.[39] However, direct flood damage to a Puerto Rico landing station occurred during Hurricane Maria, which resulted from a storm surge ranging from 1.8 to 2.7 meters (six to nine feet).[40] During this event, it was necessary to switch off the power supply to the station to prevent further damage to telecommunications equipment by the rising floodwaters.[41]

FIGURE 2 Overlap of internet infrastructure and seawater in New York (left) and Miami (right) with average sea level rise of six feet (right)

Source: Ramakrishnan Durairajan, Carol Barford, and Paul Barford, *Lights Out: Climate Change Risk to Internet Infrastructure*, fig. 4 (Jul. 16, 2018), ANRW '18: Proceedings of the Applied Networking Research Workshop, https://dl.acm.org/doi/10.1145/3232755.3232775.

FIGURE 3 Overlap of internet infrastructure based on one-foot average sea level rise in northwestern United States (top left), northeastern US (top right), Los Angeles (bottom left), and Florida (bottom right)



Note: Sea Level Rise Inundation (SLRI) is shown in blue (on green background). Submarine landing stations, point of presence (POP), data centers, and internet exchange points (IXP) are depicted in red, green, black, and yellow dots, respectively. Submarine, metro, and long-haul fiber-optic cables/conduits are shown in red, green, and black lines, respectively. Infrastructure in the SLRI-unaffected areas is grayed out.

Source: Ramakrishnan Durairajan, Carol Barford, and Paul Barford, *Lights Out: Climate Change Risk to Internet Infrastructure*, fig. 1 (Jul. 16, 2018), ANRW '18: Proceedings of the Applied Networking Research Workshop, https://dl.acm.org/doi/10.1145/3232755.3232775.

"Verizon has also elevated buildings and power stations in areas that flood," largely to address the general concern of flooding rather than as part of a strategy for a post-sea level rise infrastructure.[42] However, for cable landing stations that are "very close to the oceans and have undersea cables," sea level changes have been considered in infrastructure planning.[43] Although elevating buildings addresses flooding due to sea level rise, this tactic might not prove effective in the case of a tsunami. Some cities like Seattle are hardening their internet infrastructure to handle climate change. For instance, they are connecting public buildings with fiber-optic cable to increase resiliency in the case of flooding.[44]

Another consideration is regional power blackouts that can accompany hurricanes.[45] Loss of power to a cable landing station will impair cable repeaters.[46] Although all stations are supported by emergency backup generators, the capacity of these generators to sustain the network depends on the continued availability of fuel.[47]

EARTHQUAKES, LANDSLIDES, AND SEDIMENT AVALANCHES

Rising sea levels are only one threat in a warming world. According to Michael Clare, "Active tectonism also plays a role that can amplify the climatic forcing."[48] Terrestrial earthquakes may damage the dry plant and the impact of ground movements and resultant landslides may be felt several kilometers underwater. Earthquakes under the ocean may trigger two main types of hazards for cables: landslides and tsunamis. Therefore, earthquakes can damage both wet and dry plants. In 1929, the Grand Banks earthquake triggered undersea landslides that disrupted twelve transoceanic telegraph cables.[49] As the climate warms, ice will thaw and may also lead to liquefaction and fluid release at the seafloor. In addition, gravitational landslides and avalanches may become a bigger hazard to deep-sea fiber-optic cables.[50]

Furthermore, infrequent but powerful sediment avalanches can damage undersea cables across a vast area in the deep ocean.[51] In fact, cable breaks first generated awareness of these deep-sea events.[52] Historically, several cable breaks have been associated with natural hazards, such as typhoons, river floods, and tsunamis.[53] Unlike cable faults that are human induced, where typically only one cable is damaged, natural events have the potential to affect multiple cables at once, such as the twenty-two cable breaks as a result of the Pingtung earthquake near Taiwan in 2006.[54]

ALTERED FISHING AREAS AND SHIPPING ROUTES

Climate change has created new opportunities for some sectors such as shipping and fishing. Changes in ocean temperature cause migration of commercially valuable fish stocks, while changes in the ocean surface and formerly ice-covered areas may open new shipping routes.[55] Routes that were never used before, such as the Arctic shipping passages, are beginning to be explored.[56] More than half of cable breaks on the global network happen due to accidental anchor drops and snagged fishing gear. Thus, it is important to understand how current and future cable locations will correspond to future seabed use and vessel locations, particularly the impact of deeper fishing practices, which may mean cables need to be buried to a deeper water depth for their protection.[57]

To sum up, climate change remains a pressing issue for the integrity of the subsea cable infrastructure and the valuable data that it carries, even with some mitigation strategies in place. Recognition among regulators of the fact that climate change poses a potentially significant threat to national communications and the incorporation of substantial methods to safeguard critical infrastructure from such hazards would help prevent mass damage to the system.

HOW DOES THE LEGAL FRAMEWORK ADDRESS THE IMPACT OF CLIMATE CHANGE ON SUBSEA CABLES?

Despite its critical importance, the subsea cable system is governed only by a patchwork of rules, both nationally and internationally. The current legal framework comprises several regulations but does not provide a comprehensive system that addresses all security concerns of subsea cable systems, specifically damage from natural causes. Governments should aim for "prevention" instead of "cure" by implementing policies to avoid, or at the least mitigate, the damage caused by natural disasters. Currently, the private sector mitigates climate change–related risks through investments in engineering research and technological solutions. We claim that an additional tool to address this problem would be a well-connected, coherent regulation at all levels of governance. To that end, we survey the extant legal framework below in order to identify and evaluate the strengths and weaknesses of the system.

INTERNATIONAL LAW

Most laws and policies dwell in the legacies of the past. International law is no exception. Regulations on the protection of subsea cables are set out in several conventions going back nearly 150 years.[58] The United Nations General Assembly rightly recognizes submarine cables as "critical communications infrastructure" that is "vitally important to the global economy and the national security of all States."[59] Given the dependence of the public and private sectors on the internet carried by these cables, the NATO Cooperative Cyber Defence Centre of Excellence also clearly qualifies them as critical infrastructure.[60] However, absence of a unified legal mechanism to prepare nations for telecommunications disruption due to climate change is evident. The current framework only governs human acts of damage to cables, like anchoring and fishing, but does not address the imminent danger to subsea cables from unintentional, natural causes.[61] In addition, international law cannot legally bind those states that are not parties. Adding to that, international law's silence in recognizing this critical threat serves as a poor model for countries interested in implementing national measures to combat the problem.

UNITED STATES DOMESTIC LAW

Upon rejoining the 2015 Paris Agreement, which is a legally binding international treaty governing climate change, the Biden administration made several commitments to limit the United States' GHG emissions.[62] As a part of the United States' "nationally determined contribution" (NDC) to the agreement, the United States has committed to reduce national GHG emissions 50–52 percent by 2030.[63] However, they are not binding obligations.[64] Several cities, states, businesses, and other entities in the United States have taken up goals to reduce emissions.[65] According to *Climate Home News*, "Several states have their own emissions reduction targets, with California at the forefront of the action."[66]

Having said that, the national legal framework relating to both climate change impacts on subsea cables and subsea cables' environmental impacts is fragmented across the federal and state levels in the form of legislation, executive orders, and policies entrusting specific government agencies to address such matters. This piecemeal approach leaves a deficiency in addressing threats from climate change and in preparing the government, the public, and cable operators for outages caused by such calamities. This section first analyzes national laws governing subsea cables and then state law, in order to identify the relevant gaps in federal law.

Federal-Level Governance Framework

The federal legal framework for submarine cables comprises several pieces of legislation and policies. Crucial aspects of the framework are directly and indirectly related to the protection of subsea cables against climate impact as elaborated below. Our analysis of these rules reveals the deficiencies in the system.

Critical Infrastructure Protection US national law identifies sixteen critical infrastructure sectors, of which communications is one. Communications is especially significant, as it provides an "enabling function" across all other critical infrastructure sectors.[67] The communications sector is referred to by the Cybersecurity & Infrastructure Security Agency as an interconnected industry "using terrestrial, satellite, and wireless transmission systems."[68] Submarine cables are not categorically included in the description. There is no authoritative statutory source that designates submarine cables as critical infrastructure. One of the only policy documents that acknowledges submarine cables as "critical infrastructure," the final report of the Communications Security, Reliability and Interoperability Council (CSRIC)[69] IV Working Group 8, states, "Although the U.S. Government has identified submarine cables as critical infrastructure, no U.S. federal agency has transposed that finding in practical terms to adopt or enforce cable-protection standards or policies."[70] Given their value to national security and the economy, explicit legal recognition of submarine cables as "critical infrastructure" may demonstrate their significance and thereby include them in policies that currently apply only to other forms of communications, as mentioned above.

Cable Landing and Licensing Rules Protection of submarine cables is governed by the Submarine Cable Act.[71] Under this law, any act of willful damage to submarine telegraph cables, such as damage caused by shipping and fishing nets, is punished with fines and/or imprisonment.[72] The legislation also provides for the grant of written licenses for cable landings in the United States.[73] This law mostly encapsulates the provisions of the 1884 Convention. However, the act is in many respects obsolete. For example, the punishment for intentionally damaging or destroying a submarine cable is six months of imprisonment and a fine of $5,000, which is insufficient to deter or punish wrongdoers.

The procedural aspects of obtaining a cable landing license in the United States and of constructing and operating a cable landing station are provided under the Cable Landing License Act of 1921 (the "CLL Act").[74] This act does not refer to instances of damage to the cable landing station due to natural disasters or mention steps to prepare for such an event. It does not require standards for equipment or emergency plans from licensees to help combat natural emergencies or climate change–related events. Adding another level of complexity to the permitting regime for cables and its relevance to climate-related events, a myriad of government authorities has responsibility over submarine cable infrastructure depending on the maritime zone that is in question.[75]

The Federal Communications Commission (FCC), the authority for granting submarine cable landing licenses, has adopted a categorical exclusion under the National Environmental Policy Act of 1969 (NEPA) for the construction of new submarine cable systems, due to their low adverse impacts on the environment.[76] The FCC reserves the right to require the licensee to file an environmental assessment or modify the license should it determine that the landing of the cable at specific locations and construction of necessary cable landing stations may significantly affect the environment as mentioned under NEPA.[77]

In the *Matter of Public Employees for Environmental Responsibility (PEER): Request for Amendment of the Commission's Environmental Rules Regarding NEPA and NHPA*, the FCC denied a petition to amend its environmental rules as applied to submarine cables that require an environmental assessment (EA) for all cable landing license applications.[78] However, the FCC reserves the right to require the licensee to file an EA should it determine that the landing of the cable at a specific location or the construction of cable landing stations may significantly affect the environment.[79] In the above petition, PEER made the argument that the FCC's environmental rules are "obsolete because of the 'explosive growth' in wireline and wireless infrastructure since the enactment of the Telecommunications Act of 1996," thereby altering the circumstances that require the FCC to look at the cumulative environmental impacts of the ICT sector, including submarine cable landing licenses when aggregated across the nation.[80] Although the FCC rejected this contention in 2001, the essence of the argument remains largely relevant in today's discussion due to the proliferation of internet-based services and businesses.

In practice, the FCC reportedly considers climate change when assessing cable routes for new cable systems that apply for landing licenses. However, a similar protection for existing cable landing stations is still missing.

The CLL Act has a notable requirement that mandates licensees to file detailed submarine cable outage reports in the form of notification, interim, and final reports.[81] This requirement applies, inadvertently, even during times of outages caused by natural disasters, which aids in mitigating the impact of the calamity on cables.

Cables in Environmentally Sensitive Areas NOAA is authorized to regulate whether and how proposed submarine cables may be installed in environmentally sensitive areas. It also administers the Coastal Zone Management Act (CZMA),[82] which provides that "no federal agency may grant a license to conduct an activity affecting a coastal area until a proposed activity is consistent with the state's coastal management plan."[83] If a state includes FCC cable landing licensing in its coastal management plan, FCC licensing would be considered a "listed activity" and the state would have six months to review and either concur with or object to the certification that is required.[84]

Policy Measures Relating to Climate Change in General Aside from federal and state laws governing cables specifically, executive branch policy measures govern US climate change policy more generally. For instance, a 2013 executive order—"Preparing the United States for the Impacts of Climate Change"—aimed to improve the nation's preparedness and resilience for the impacts of climate change.[85] The policy set forth by the executive order advocates strong partnerships, interagency coordination, and information sharing at all levels of government, as well as risk-informed decision making. Adaptive learning is also key to the policy, and the executive order mandates that experiences should serve as opportunities to inform and adjust future actions as well as preparedness planning.[86] The executive order does not include a discussion of emergency communication channels or the resilience of submarine cables. Yet, it is noteworthy that a subsequent "Communications Sector-Specific Plan" issued by the US Department of Homeland Security in 2015 recognizes accidents such as submarine cable damage as one of the sector risks.[87]

Policies on Cable Security The CSRIC has made some recommendations to improve undersea cable security, but these efforts will only aid in improving the legal protection for subsea cables in general. It does not address the potential effects of climate change on subsea cables. Legal recognition to mitigate damage due to such events needs specific attention and motivation.[88]

Multiple Government Bodies Three federal agencies play a role in dealing with environmental issues relevant to critical infrastructure. The National Infrastructure Advisory Council (NIAC) provides the president, through the secretary of homeland security, with advice on the security and resilience of critical infrastructure sectors and their functional systems, physical assets, and cyber networks.[89] One of the important functions of NIAC is to propose and develop ways to encourage private industries to perform periodic risk assessments and implement risk-reduction programs.[90] NIAC also monitors the development and operations of critical infrastructure sector coordinating councils and their information-sharing mechanisms and provides recommendations to the president on how these organizations can best foster improved cooperation among the sectors, the Department of Homeland Security, and other federal government entities.[91]

The National Coordinating Center for Communications (NCC) is entrusted with the duty of continuously monitoring national and international incidents and events that may impact emergency communications, including natural events such as tornadoes, floods, hurricanes, and earthquakes.[92] However, it is not clear if attending to and managing disruption in communication lines or the internet as a result of damage to subsea networks is included within the scope of NCC.

The US Army Corps of Engineers (the corps) is another federal agency with authority over undersea cable laying.[93] The location of the cable system within the territorial waters of the United States, its territories and possessions, and upon its shores must be in conformity with plans approved by the corps.[94] The corps is also empowered to regulate artificial islands, installations, and "devices" (which can include submarine cables) on the seabed of the United States' outer continental shelf.[95] Although the corps's regulatory review is focused on cables' potential impacts on navigation and national security,[96] it also performs environmental analyses pursuant to NEPA,[97] unless another agency has authority over the permitting of the cable in question. The corps assesses coastal climate impacts and may include conditions relating to where the cable can land, the cable landing station, and cable burial in its permit.[98] The corps also handles climate change mitigation on the coasts from beach erosion, flooding, and construction and protection.[99]

Resiliency of Cable Ships The Federal Cable Ship Security Program helps to address the issue of cable breakage to an extent. It is a new initiative for government-licensed, privately operated ships to quickly repair damaged cables carrying government or military data.[100] Currently, two US-flagged cable ships, CS *Dependable* and CS *Decisive*, operate in the Pacific Ocean and Atlantic Ocean, respectively.[101] These ships carry out normal commercial work but can support the US government in an instant if activated. This could be a boon during climate disasters as cable ships could be mobilized for quick remediation. Unfortunately, the US government halted funding for the modest $10 million annual stipend needed to continue the program after its first year of operation.[102]

Increasing Importance to Physical Damage to Cables The CLL Act deals elaborately with security issues such as foreign ownership of the cable network or use of equipment from reliable manufacturers, among other related concerns. It is true that these factors constitute top priority threats to national security. The Committee for the Assessment of Foreign Participation in the United States Telecommunications Services

Sector, informally called Team Telecom, is responsible for preventing security failures. In this context, security means limiting involvement with certain foreign countries; for example, refusing permits to land in the United States to international cable systems that land in China. But the increasing need for protection of cables against climate change–related disasters and the absence of a policy framework to address it leave the nation less equipped to handle such situations.

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An analysis of the United States' regulatory framework on submarine cables exposes its shortcomings. There is a glaring gap in the legislative and policy framework: the lack of any reference or preparatory steps to prevent damage to subsea cables due to natural calamities, especially for existing cable systems. This topic has been overlooked as trends in cable faults over the years suggest that natural disasters are not the major cause of network outages (they account for less than 10 percent of global cable faults).[103] What is missing from the existing legal system is a unified set of rules, for existing and new cables, that connects the different laws and policies and their enforcing agencies, thereby enhancing clarity of law and preventing uncertainty. This is crucial for subsea cable operators and owners to plan their business operations and make relevant decisions.

State and Local Laws

US federal law establishes the licensing framework and weaves environmental compliance into it to some extent. But the role of state and local laws in this process cannot be ignored. Before filing an application to the FCC for a license to construct and operate a submarine cable system or to modify a previously approved cable system, applicants need to determine whether they are required to certify that their proposed activities will comply with the enforceable policies of a state's approved coastal zone management plan.[104] State coastal zone management agencies, operating under the CZMA, issue permits for cable landings that, in most cases, extend beyond the territorial sea throughout the two hundred nautical miles called the exclusive economic zone (EEZ).

State and city rules recognize the need to address climate impacts in their infrastructure planning. In fact, siting and design decisions such as retrofitting (elevating buildings and so on) as well as land use planning and management are the responsibility of the state or local governments.[105] Several coastal states, such as New York, California, and Washington, possess equivalent statutes that are similar to NEPA but require different levels of detail in technical analyses of effects.[106] Four jurisdictions that are susceptible to sea level rise and have cable landings are examined as examples of state and city-level regulatory frameworks under this section. Since important landing points face significant threat of climate change, the expectation that these state laws will provide formidable measures to protect cables against sea level impacts is not satisfied. Although the cable industry may consider that the system is sufficient to withstand the impact, protected by proactive engineering initiatives by cable companies, we argue that climate change has the potential to create impacts that might surpass the protection offered by these measures.

California Despite creating a policy framework to address climate change, especially risks due to sea level rise, California does not provide a robust approach to cable landing stations. California includes telecommunications within its definition of critical infrastructure, although it does not specify submarine cables explicitly. A report by the California Coastal Commission (CCC), *Critical Infrastructure at Risk: Sea Level Rise Planning Guidance for California's Coastal Zone*, adopted in 2021, focuses on transportation and water, but not telecommunications.[107]

The CCC has the primary responsibility in the coastal zone to implement the state's Coastal Management Program and the Coastal Act,[108] developing permit conditions and policies necessary to adapt to hazards. Local governments are required to integrate sea level rise planning into land use decision-making processes under the Coastal Act.[109]

Like some other states, California's state environmental laws have a role in incorporating climate change–based assessments into the cable licensing process. The California State Lands Commission (CSLC) performs the environmental review and writes the environmental document associated with granting a lease of state sovereign submerged lands.[110] In areas where a local jurisdiction owns the seabed, that town will complete a similar process.[111] The CCC conducts its own review after the CSLC (or local entity) has completed its review.[112] Recently, this environmental review process has taken approximately two years to complete.[113]

New York New York City, one of the most vulnerable metropolitan areas, could lose nearly 20 percent of its metro conduit and 32 percent of its long-haul conduit to rising sea levels.[114] The New York City Climate Change Adaptation Task Force was told to assess the vulnerabilities of the city's critical infrastructure and identify more than one hundred types of infrastructure, including communications, that climate change could affect.[115] The Task Force explored strategies to reduce risk using protection measures such as seawalls, watertight gates, soft or graduated edges, and increased resilience of existing infrastructure.[116] New York's policy strives to make existing building code regulations consistent with federal standards and requires the floodproofing of all buildings located within the Federal Emergency Management Agency (FEMA) 1-percent-annual-chance flood zone.[117] This entails measures such as raising critical building systems above the FEMA base flood elevation. According to the report, "Establishing guidelines and standards for the design of waterfront infrastructure can facilitate the protection of development areas while minimizing damage and maximizing ecological benefits."[118]

Miami Miami is one of the most vulnerable US cities in the face of potential present and future climate change harms. All local Floridian cities are required by Florida law to create, adopt, and maintain long-range comprehensive plans to guide growth and development.[119] The Florida Legislature in 2011 passed the Community Planning Act, which allows local governments the option to designate areas that experience coastal flooding and are vulnerable to sea level rise as "adaptation action areas."[120] Priority is given to such designated areas for "infrastructure funding and adaptation planning."[121] Local governments that adopt an adaptation action area may consider management policies to enhance flooding resilience from natural hazards such as storm surges, flash floods, and sea level rise, among others.[122] There appears to be no specific rule to deal with subsea cable infrastructure during natural hazards.

Massachusetts Massachusetts' Oceans Act of 2008 stipulates that the integrated ocean management plan addresses climate change and sea level rise.[123] Importantly, "telecommunication cables" are recognized as important infrastructure components. The ocean plan has a section on cables and pipelines and addresses them through siting and performance standards.[124] However, a clear contemplation of the role of climate change on cable systems is not evident from the statute or the plan.

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Most of the studied state or city-level laws do not explicitly recognize the significance of subsea cable infrastructure and what its damage means to regional and national security. Their assessment of the sectors vulnerable to climate change is not complete without including the subsea cable industry. There is a gap in their preparedness and planning that may currently be filled by proactiveness by the industry itself, but these efforts may not be sufficient to the unknown threats that future climatic behaviors might present.

MITIGATION MEASURES

This section examines efforts by the private sector to protect subsea cables to make them climate change–proof or at least more resilient to climate-related events. We then highlight why these private sector initiatives are insufficient, emphasizing the need for law and policy measures.

SPECIFICITY OF THE SUBSEA CABLE INDUSTRY AND ITS INFLUENCE ON CLIMATE MITIGATION

Unlike other critical infrastructure sectors such as transportation and financial services, the subsea cable industry has enjoyed long-standing freedom from governmental control and interference. Despite this, the industry has performed well historically in terms of establishing and maintaining US connectivity with the rest of the world. Many agree that this very freedom has enabled the industry's success in doing so.[125]

The industry is collectively a close-knit group of engineers, mariners, and commercial operators whose technical skills and trade know-how date back to the 1800s and continue to the present day. Although from a macro perspective damage to subsea cables is a national security issue, when considered from the vantage point of subsea cable owners, the fact that climate change is ultimately going to upset their investments is a fundamental motivation to upgrade their infrastructure and adopt actions to adapt to changing climatic circumstances.

The cable assets, wet plants in particular, are predominantly built with the owners' funds and are self-insured. As a result, cable owners and operators carefully assess all impacts that may be an issue under the twenty-five-year design life of a submarine cable system. Methods that are effective against hazards associated with climate change (some of which have already been adopted by cable owners) include changing from copper wires to fiber-optic cable, increasing cable armoring with or without burial at shore ends where erosion is worsening, shifting new landing stations to higher elevations or, where possible, further inland, avoiding low-lying areas for beach manholes, and developing resilient networks (cable owners and operators typically develop networks consisting of multiple cables that provide redundant paths to the same locations in the event of cable damage).[126] Older landing stations, however, need to be reinforced against the impacts of climate change or possibly moved if necessary.[127]

Local knowledge of environmental conditions and historical events gathered from site visits informs the cable-laying companies of potential threats. Optimal routes and landing points are identified by geographic information system (GIS) analysis using various geospatial datasets that are incorporated into desktop studies before cable laying is initiated.

The industry is also responding through the development of technological measures. Open cable systems now take the submarine line terminal equipment (SLTE) out of the cable landing station and place it in the points of presence located several kilometers from the beach, which will help to mitigate the effect of climate change.[128] As pointed out earlier, some communications giants like AT&T and Verizon are already deploying systems and strategies to survive the rising tide. However, not all companies may be adopting these measures. Such actions must become the rule in today's changing world, not the exception.[129]

As a concerted industry-wide organization, the ICPC, especially in the recent past, has devoted considerable time and effort to educate its members and other stakeholders about climate change by publishing several bulletins and reports to members.[130] Due to this, it seems that climate change is an area understood by the owners and operators of submarine cables as well as the manufacturers and cable ship operators that build and maintain them. Furthermore, at a consultative meeting of the United Nations on sea level rise and its impacts, the ICPC argued that "sea level rise be considered in future route and landing station planning, as well as assessing the risk posed to existing systems."[131]

Irrespective of the independent efforts of the industry, safeguarding investment alone does not form a robust, long-standing motivation to defend national security. Subsea cables are assets of critical national importance and a national will in the form of legal measures is fundamental to protecting them against an actor not yet fully considered by extant law: changing nature and climate.

LAW AND POLICY—A FORGOTTEN TOOL

Having reviewed the law and policy concerning climate change's potential effects on subsea cables and understanding the efforts of the industry to mitigate these impacts, we suggest that a strong, appropriate law and policy framework is a missing piece of the puzzle of addressing escalating climate change–related problems for subsea cables in the near future, as noted by the Lights Out Report.

An ideal regime would include the government adopting a more preemptive policy in applying its climate rules to the subsea sector (and not just to other critical infrastructure sectors). To support compliance of the private sector with the policy, better incentives or subsidies might be offered. The industry, on the other hand, can continue to develop technological resilience to climate change but would more formally engage with and receive support from the government. This section emphasizes the problems that exist in the current system.

The Three Basic Problems

Three fundamental problems remain in the US legal system with regard to submarine cable governance that affect its capacity to address climate change. First, there are multiple departments, agencies, or authorities—twenty-one federal and state-level bodies, precisely—having jurisdiction over different aspects of the subsea cable infrastructure.[132] Every agency assumes authority over one or more aspects of the cable infrastructure, but no single agency is responsible for the entire system.

Second, there is insufficient coordination among agencies of federal, state, and local governments regarding specifying and enforcing standards and regulations.[133]

Third, there is a web of federal and state rules to assess environmental impacts of a cable system during the licensing process. Many of them do not, however, appear to include climate change–based analysis in licensing decisions. Although the laws are not clear on this, in practice, coastal zone management agencies are reported to be sensitive to climate impacts and to assert conditions they consider necessary to protect both the environment and the cable infrastructure from climate impacts over the life of the cable system.[134]

We believe that a robust system of rules to counteract climate change and its effects on subsea cable networks in the United States may add a layer of protection against this critical threat.

CONCLUSION

The impacts of climate change are not fully predictable. Although the industry has applied proactive mitigation methods and adaptive engineering to counter sea level rise and other climate impacts for now, in the long run it is unclear if these strategies, driven by market competition and securing investments, will be sufficient. Protection of subsea systems is an important national security issue, and that factor needs to be recognized when adopting climate change–resilient policies encompassing the subsea cable network.

In order to enforce best practices to protect subsea cables against adverse impacts associated with a changing climate on a sector-wide basis, rather than depending on the capacity and will of the private companies, regulation is the most effective tool. Just as in other industries where the technology advances and the law has to catch up, the legal framework needs to advance itself to cover this area.

If carefully and coherently used, law and policy can be wielded as effective tools to mitigate the impact of climate change. There are federal and state or city policies that recognize the oncoming threat of climate change. Despite these important efforts, these fragmented pieces of legislation or policies do not categorically apply to subsea cable infrastructure in most jurisdictions. This regulatory gap in the current system means that streamlining existing policies may become necessary to increase resiliency in the face of climate change, especially to preserve national interests. We hope that a strong legal framework will be in place before any catastrophe occurs and is not enacted as a response to it.

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NOTES

1. In this paper, we scrutinize the entire stretch of a subsea network, including the network components onshore (the dry plant) alongside the undersea segments (the wet plant). Other enablers of the internet such as data centers are not included in this study. Likewise, while there are two distinct threats—digital and physical—that may challenge the integrity of the data carried by such cables, our paper focuses on the latter, and primarily on natural hazards to the material integrity of the overall system. The terms "subsea" and "submarine" are used interchangeably throughout this paper, and they refer to the same internet infrastructure under the ocean that carries global data. Although this is a security issue with global ramifications, we focus on the topic from the perspective of the United States—from the national to the local level—and do not cover other jurisdictions. In the subsea cable network, dry plant refers to beach manholes where the undersea cables terminate onshore. They are then connected to the

cable landing station, a popular form of "node" in telecommunication networks. The wet plant includes subsea cables connected to repeaters at regular intervals to relay information through the full stretch of the cable system. These cables and repeaters are laid by specialized ocean vessels that are designed for cable laying and maintenance. Fiber-optic cables are typically not larger than the size of a garden hose.

2. *See, e.g.*, James Griffiths, *The Global Internet Is Powered by Vast Undersea Cables. But They're Vulnerable*, CNN (Jul. 26, 2019, 7:30 AM), https://www.cnn.com/2019/07/25/asia/internet-undersea-cables-intl-hnk/index.html [https://perma.cc/XR9Z-8JNN].

3. *See* Nadia Schadlow & Brayden Helwig, *Protecting Undersea Cables Must Be Made a National Security Priority*, DefenseNews (Jul. 1, 2020), https://www.defensenews.com/opinion/commentary/2020/07/01/protecting-undersea-cables-must-be-made-a-national-security-priority/ [https://perma.cc/PQ8R-HH4H].

4. *See* Lionel Carter et al., Int'l Cable Protection Comm., Submarine Cables and the Oceans: Connecting the World 45, 47 (2009).

5. *See* Simon Scarr et al., *The Race to Reconnect Tonga*, Reuters (Jan. 28, 2022), https://www.reuters.com/graphics/TONGA-VOLCANO/znpnejbjovl/ [https://perma.cc/2HP5-Q3QN].

6. See Griffiths, *supra* note 2.

7. Ramakrishnan Durairajan, Carol Barford, and Paul Barford, *Lights Out: Climate Change Risk to Internet Infrastructure* (Jul. 16, 2018), ANRW '18: Proceedings of the Applied Networking Research Workshop, https://dl.acm.org/doi/10.1145/3232755.3232775 [https://perma.cc/PXW2-QHF7].

8. *Id*.

9. *Id.* at 6.

10. *See* Michael Clare, *Climate Change Hotspots and the Global Telecommunications Network*, Nat'l Oceanography Centre, https://noc.ac.uk/projects/climate-change-global-telecoms [https://perma.cc/HQB8-XKGK].

11. Michael Clare et al., *Climate Change Hotspots and Implications for the Global Subsea Telecommunications Network*, 237 Earth-Sci. Revs. (Feb. 2023).

12. Jill C. Gallagher, Cong. Rsch. Serv., R47237, Undersea Telecommunication Cables: Technology Overview and Issues for Congress (2022), https://crsreports.congress.gov/product/pdf/R/R47237 [https://perma.cc/RP4F-8CCB].

13. *Id*.

14. *Id*. at 19–21.

15. *See* Michael Clare, Int'l Cable Protection Comm., Submarine Cable Protection and the Environment 6 (2020).

16. *See id*.

17. *See id*. at 7–9.

18. *See* Peter Adams et al., Gen. Servs. Admin., Climate Risks Study for Telecommunications and Data Center Services 5 (2014), https://sftool.gov/Content/attachments/GSA%20Climate%20Risks%20Study%20for%20Telecommunications%20and%20Data%20Center%20Services%20-%20FINAL%20October%202014.pdf [https://perma.cc/J45F-YK2W].

19. *See* Nicole Starosielski, The Undersea Network 2, 40–41, 44 (2015).

20. *See* Clare, *supra* note 15, at 11.

21. *See* Adams et al., *supra* note 18, at 5.

22. *See id*.

23. *See id*.

24. *See id*.

25. Kristen L. Miller et al., Conn. Off. of Leg. Rsch., Sea-Level Rise Adaptation Policy in Various States (2012), https://www.cga.ct.gov/2012/rpt/2012-R-0418.htm [https://perma.cc/9CYD-CCWJ].

26. *Id*.

27. Carol Barford, *Key Internet Connections and Locations at Risk from Rising Seas*, Conversation (Sep. 7, 2018, 6:45 AM), https://theconversation.com/key-internet-connections-and-locations-at-risk-from-rising-seas-101167#:~:text=The%20effects%20of%20rising%20waters&text=Thousands%20of%20miles%20of%20cables,called%20%E2%80%9Cpoints%20of%20presence.%E2%80%9D [https://perma.cc/ZP2Q-BY7D].

28. *Id*. (citing William V. Sweet et al., Nat'l Oceanic & Atmospheric Admin., Global and Regional Sea Level Rise Scenarios for the United States 40 (2017), https://tidesandcurrents.noaa.gov/publications/techrpt83_Global_and_Regional_SLR_Scenarios_for_the_US_final.pdf [https://perma.cc/963L-8GBW]).

29. *See* Clare et al., *supra* note 11, at *2.

30. *See* Zac Anderson, *Irma Outages Spur Grid Review*, Herald-Tribune (Sept. 23, 2017, 6:39 PM), https://www.heraldtribune.com/story/weather/hurricane/2017/09/23/irma-power-outages-spark-review-of-electric-grid/18744201007/ [https://perma.cc/S2BB-52PG].

31. *See* Clare, *supra* note 10, at *2–3.

32. Clare, *supra* note 15, at 7.

33. Barford, *supra* note 27.

34. *Id*.

35. *Id*.

36. *See* Durairajan, *supra* note 7, at 2.

37. Rebecca Hersher, *Rising Seas Could Cause Problems for Internet Infrastructure*, NPR (Jul. 16, 2018, 2:53 PM), https://www.npr.org/2018/07/16/627254166/rising-seas-could-cause-problems-for-internet-infrastructure [https://perma.cc/56L5-NSW8].

38. *See id*.

39. *See* Clare et al., *supra* note 11, at 9.

40. *See* FEMA, Hurricanes Irma and Maria in Puerto Rico: Building Performance, Observations, Recommendations, and Technical Guidance at 1–10 (2018); Doug Madory, *Puerto Rico's Slow Internet Recovery*, Medium (Dec. 7, 2017), https://medium.com/oracledevs/puerto-ricos-slow-internet-recovery-defaa0ebffc3 [https://perma.cc/YW37-3DLB].

41. *See* Madory, *supra* note 40.

42. Hersher, *supra* note 37.

43. *Id*.

44. *See id*.

45. *See* Alexis Kwasinski, *Lessons from Field Damage Assessments about Communication Networks Power Supply and Infrastructure Performance during Natural Disasters with a Focus on Hurricane Sandy* 9 (Feb. 3, 2013) (unpublished manuscript) (on file with author).

46. *See* Carter et al., *supra* note 4, at 44.

47. *See* Adams et al., *supra* note 18, at 22.

48. *See* Clare et al., *supra* note 11, at 15.

49. See Rob Goodier, *How Climate Change Could Break the Internet*, Popular Mechs. (Jul. 19, 2018), https://www.popularmechanics.com/technology/infrastructure/a22454576/climate-change-internet-damage [https://perma.cc/5XAL-BYY9].

50. *See id*.

51. *See* Clare, *supra* note 15, at 10.

52. *See id*.

53. *See* Ed. L. Pope et al., *Damaging Sediment Density Flows Triggered by Tropical Cyclones*, 458 Earth & Planetary Sci. Letters, 2017, at 161, 162; L. Carter, *Near-Synchronous and Delayed Initiation of Long Run-Out Submarine Sediment Flows from a Record-Breaking River Flood, Offshore Taiwan*, 39 Geophysical Rsch. Letters, June 21, 2012, at 1; Rachel Gavey et al., *Frequent Sediment Density Flows during 2006 to 2015, Triggered by Competing Seismic and Weather Events: Observations from Subsea Cable Breaks Off Southern Taiwan*, 384 Marine Geology 147, 147 (2017); Lionel Carter, Rachel Gavey, Peter J. Talling, and James T. Liu, *Insights into Submarine Geohazards from Breaks in Subsea Telecommunication Cables*, 27 Oceanography 58, 59 (2014) [hereinafter Carter et al., *Insights*].

54. *See* Carter et al., *Insights*, *supra* note 53, at 59.

55. *See* Clare, *supra* note 15, at 7.

56. *See* Clare et al., *supra* note 11, at 14.

57. *See* Carter et al., *supra* note 4, at 3, 47; Carter et al., *Insights*, *supra* note 53, at 59.

58. The international law on subsea cables is set out in four conventions, namely, the 1884 Convention for the Protection of Submarine Telegraph Cables (the 1884 Convention), Mar. 14, 1884, 24 Stat. 989, the 1958 Convention on the High Seas (the 1958 HS Convention), Apr. 29, 1958, 13 U.S.T. 2312, 450 U.N.T.S. 82, the 1958 Convention on the Continental Shelf (the 1958 CS Convention), Apr. 29, 1958, 15 U.S.T. 471, 499 U.N.T.S. 311, and the 1982 United Nations Convention on the Law of the Sea (UNCLOS), Dec. 10, 1982, 1833 U.N.T.S. 3. More information about international governance of subsea cables may be found in Douglas R. Burnett et al., Submarine Cables: The Handbook of Law and Policy (2014).

59. G.A. Res. 66/231, at 22 (Apr. 5, 2012) (first quotation); *id*. at 4 (second quotation).

60. *Strategic Importance of, and Dependence on, Undersea Cables*, Nato Cooperative Cyber Defence Centre of Excellence, Nov. 2019, at *1, https://ccdcoe.org/uploads/2019/11/Undersea-cables-Final-NOV-2019.pdf [https://perma.cc/N3BR-CGUE].

61. *See, e.g.*, Convention for the Protection of Submarine Telegraph Cables, *supra* note 58, at arts. V, VI, VII.

62. *See* Nathan Rott, *Biden Moves to Have U.S. Rejoin Climate Accord*, NPR (Jan. 20, 2021, 5:45 PM), https://www.npr.org/sections/inauguration-day-live-updates/2021/01/20/958923821/biden-moves-to-have-u-s-rejoin-climate-accord [https://perma.cc/WDS2-5ES5]; *The Paris Agreement*, United Nations, https://www.un.org/en/climatechange/paris-agreement [https://perma.cc/J5NJ-NHGA].

63. *See* Press Release, The White House, *Fact Sheet: President Biden Sets 2030 Greenhouse Gas Pollution Reduction Target Aimed at Creating Good-Paying Union Jobs and Securing U.S. Leadership on Clean Energy Technologies* (Apr. 22, 2021), https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/22/fact-sheet-president-biden-sets-2030-greenhouse-gas-pollution-reduction-target-aimed-at-creating-good-paying-union-jobs-and-securing-u-s-leadership-on-clean-energy-technologies/ [https://perma.cc/7KSG-8WDE].

64. *See, e.g.*, Letter from Julia Frifield, Assistant Sec'y for Legis. Aff., U.S. Dep't of State to Sen. Bob Corker, Chairman, Senate Comm. on Foreign Rels. (Mar. 16, 2016) (noting that even after ratification, the US emissions reduction contribution "will not, by the terms of the Agreement, be legally binding," since "[n]either Article 4, which addresses emissions mitigation efforts, nor any other provision of the Agreement obligates a Party to achieve its contribution"); Press Release, U.S. Dep't of State, Special Briefing by Senior Administration Officials, Background Briefing on the Paris Climate Agreement (Dec. 12, 2015), https://2009-2017.state.gov/r/pa/prs/ps/2015/12/250592.htm [https://perma.cc/HH4G-BF7N] ("[T]he notion of the targets not being binding was really a fundamental part of our approach from early on. . . . The targets are not binding; the elements that are binding are consistent with already approved previous agreements.").

65. *Climate Change Laws in the USA*, Climate Home News (June 2018), https://www.climatechangenews.com/2013/02/12/in-focus-usas-climate-laws/ [https://perma.cc/9HGP-QN4P].

66. *See id*.

67. *Communications Sector*, Cybersecurity & Infrastructure Sec. Agency, https://www.cisa.gov/communications-sector [https://perma.cc/US8L-LDZY].

68. *Id*.

69. *Communications Security, Reliability and Interoperability Council (CSRIC V)*, Fed. Comm. Comm'n, https://www.fcc.gov/about-fcc/advisory-committees/communications-security-reliability-and-interoperability [https://perma.cc/5PRX-L48L].

70. Working Group 8, Submarine Cable Routing and Landing, Final Report—Protection of Submarine Cables through Spatial Separation (2014), https://transition.fcc.gov/pshs/advisory/csric4/CSRIC_IV_WG8_Report1_3Dec2014.pdf [https://perma.cc/QS3N-85J5] [hereinafter Working Group 8].

71. 47 U.S.C. §§ 21–39.

72. *Id*. §§ 24–25.

73. *Id*. §§ 34–39.

74. *Id*.

75. The US Department of Homeland Security is responsible for protection of cables on land, the US Coast Guard up to twelve nautical miles (that constitutes the US territorial sea), and the US Navy beyond twelve nautical miles. Depending on the nature of the proposed cable system or its location, other federal agencies may have regulatory authority. *Submarine Cables – Domestic Regulation*, Nat'l Oceanic & Atmospheric Admin., https://www.noaa.gov/gc-international-section/submarine-cables-domestic-regulation [https://perma.cc/58KF-6P93].

76. *See* 47 C.F.R. § 1.1306 n.1 (2023).

77. *See* 47 C.F.R. § 1.767(g)(9) (2023). *See also* 47 C.F.R. § 1.1307(a) and (b) of the National Environmental Policy Act of 1969 for more information on "significantly affecting the environment." 47 C.F.R. § 1.1307 (2023) (requiring the preparation of environmental assessments (EAs) for actions that may have a significant environmental effect).

78. Pub. Emps. for Env't Resp., 16 FCC Rcd. 21439 (2001). PEER argues that the Commission's rules, which allow applicants and others to certify whether or not proposed activities (e.g., the laying of domestic fiber-optic line or the construction of a communications tower) may significantly affect the environment, result in industry self-regulation, and that this process does not ensure compliance with NEPA and NHPA. According to PEER, only an environmental assessment or environmental impact statement contains sufficient scientific evidence to support conclusions regarding whether the environment will be endangered, and in the absence of such documents "all FCC licenses may be invalid and without effect."

79. 47 C.F.R. §§ 1.767(g)(9)–1.1307 (2023). Actions that may have a significant environmental effect, for which environmental assessments (EAs) must be prepared:

(a) Commission actions with respect to the following types of facilities may significantly affect the environment and thus require the preparation of EAs by the applicant (see §§ 1.1308 and 1.1311) and may require further Commission environmental processing (see §§ 1.1314, 1.1315 and 1.1317):

> (1) Facilities that are to be located in an officially designated wilderness area.
> (2) Facilities that are to be located in an officially designated wildlife preserve.
> (3) Facilities that:
>> (i) May affect listed threatened or endangered species or designated critical habitats; or
>> (ii) are likely to jeopardize the continued existence of any proposed endangered or threatened species or likely to result in the destruction or adverse modification of proposed critical habitats, as determined by the Secretary of the Interior pursuant to the Endangered Species Act of 1973.

80. Pub. Emps. for Env't Resp., 16 FCC Rcd. 21439, 21442–43 (2001).

81. 47 C.F.R. § 1.767(g)(16) (2023). This is described in 47 C.F.R. § 4.15 (2023).

82. 16 U.S.C. §§ 1451–66.

83. The CZMA provides that no federal agency may grant a license to conduct an activity affecting a coastal area until a state concurs or is presumed to concur with the applicant's certification that a proposed activity is consistent with the state's coastal management plan. 16 U.S.C. § 1456(c)(3)(A).

84. This happens if CZMA state consistency review is triggered by the filing of a cable landing license with the FCC. *See* 15 C.F.R. § 930.53 (2023). If the state does not include FCC cable landing licensing in its coastal management plan, such licensing is an "unlisted activity" for which NOAA rules require that the state notify the relevant federal agencies, applicant(s), and the Director of NOAA's Office of Ocean and Coastal Resource Management of the state's request to review the activity. *See* 15 C.F.R. § 930.54 (2023).

85. Exec. Order No. 13,653, 3 C.F.R. § 330 (2014).

86. *Id*.

87. U.S. Dep't of Homeland Sec., Communications Sector-Specific Plan: An Annex to the NIPP 2013 7 (2015), https://www.cisa.gov/sites/default/files/publications/nipp-ssp-communications-2015-508.pdf [https://perma.cc/29XS-EAHT].

88. Notable recommendations include the creation of cable protection zones; improved interagency coordination on cable routing; the diversification of routes to increase resiliency and redundancy; the creation of spatial separation requirements or standards to avoid damage from competing marine activities (e.g., installation of power cables and wind farms); and coordination between federal, state, and local agencies and industry (e.g., fishing, shipping) to improve awareness of undersea telecommunication cable vulnerabilities and security needs. *See* Gallagher, *supra* note 12, at 18–21.

89. *See The President's National Infrastructure Advisory Council (NIAC)*, Cybersecurity & Infrastructure Sec. Agency, https://www.cisa.gov/resources-tools/groups/presidents-national-infrastructure-advisory-council-niac [https://perma.cc/AS4U-Q9T7].

90. *See id*.

91. Exec. Order No. 13,653, 3 C.F.R. § 330 (2014).

92. *See National Coordinating Center for Communications*, Cybersecurity & Infrastructure Sec. Agency, https://www.cisa.gov/resources-tools/programs/national-coordinating-center-communications [https://perma.cc/Q8NL-6Q6J].

93. *See Submarine Cables – Domestic Regulation*, *supra* note 75.

94. *See* 47 C.F.R. § 1.767(g)(2) (2023).

95. *See* 33 U.S.C. § 403; 43 U.S.C. § 1333(e); 33 C.F.R. § 320.2(b) (2023). International submarine telecommunication cables that are not connected to offshore structures like an oil well are not considered "devices."

96. *See* 33 C.F.R. §§ 320.2, 320.4(j)(2) (2023).

97. *See* 42 U.S.C. §§ 4321, 4331–35.

98. Anonymous Source, Personal Communications (Nov. 15, 2022).

99. Anonymous Source, Personal Communications (Nov. 15, 2022).

100. *See* Justin Sherman, *The U.S. Should Get Serious about Submarine Cable Security*, Council on Foreign Rels. (Sept. 13, 2021, 6:12 PM), https://www.cfr.org/blog/us-should-get-serious-about-submarine-cable-security [https://perma.cc/LM9Q-J7VY].

101. *See* Douglas R. Burnett, *Repairing Submarine Cables Is a Wartime Necessity*, U.S. Naval Inst. (Oct. 2022), https://www.usni.org/magazines/proceedings/2022/october/repairing-submarine-cables-wartime-necessity [https://perma.cc/5KV6-EJW5].

102. *See id*.

103. *See* Carter et al., *supra* note 4, at 9.

104. *See* 47 C.F.R. § 1.767(a)(10) (2023).

105. Rachel Ehlers, Legis. Analyst's Off., Preparing for Rising Seas: How the State Can Help Support Local Coastal Adaptation Efforts 9 (2019).

106. *See* Final Report—Interagency and Interjurisdictional Coordination, Commc'ns Sec., Reliability & Interoperability Council, Working Group 4A Submarine Cable Resiliency 33 (2016), https://transition.fcc.gov/bureaus/pshs/advisory/csric5/WG4A_Report-Intergovernmental-Interjurisdictional-Coordination_June2016.pdf [https://perma.cc/226G-LQBY] [hereinafter Interagency and Interjurisdictional Coordination].

107. *See* Cal. Coastal Comm'n, Critical Infrastructure at Risk: Sea Level Rise Planning Guidance for California's Coastal Zone (2021), https://documents.coastal.ca.gov/assets/slr/SLR%20Guidance_Critical%20Infrastructure_12.6.2021.pdf [https://perma.cc/T2KZ-V2YY].

108. Cal. Pub. Res. Code § 30000–30824 (2023).

109. *See* Cal. Pub. Res. § 30501.

110. *See* Interagency and Interjurisdictional Coordination, *supra* note 106.

111. *See id*.

112. *See id*.

113. *See id*.

114. *See* Goodier, *supra* note 49.

115. *See* Dep't of City Plan., City of N.Y., Vision 2020: New York City Comprehensive Waterfront Plan 108 (2011), https://www.nyc.gov/site/planning/plans/vision-2020-cwp/vision-2020-cwp.page [https://perma.cc/9FGZ-VYSA].

116. *See id*. at 110.

117. *See id*. at 109.

118. *See id*. at 111.

119. *See* Fla. Stat. Ann. § 163.3167 (West 2022).

120. Miller et al., *supra* note 25.

121. *See id*.

122. *See* Fla. Stat. Ann. § 163.3164 (West 2021); Fla. Stat. Ann. § 163.3177(5)(g) (West 2019).

123. 2008 Mass. Acts. 173.

124. *See* Exec. Off. of Energy & Env't Aff., Review of the Massachusetts Ocean Management Plan 10 (2020), https://www.mass.gov/doc/review-of-the-massachusetts-ocean-management-plan-december-2020/download [https://perma.cc/GPA7-RB2G].

125. *See, e.g.*, Douglas R. Burnett, *Submarine Cable Security and International Law*, 97 Int'l L. Studs. 1659, 1670 (2021).

126. *See* Hersher, *supra* note 37.

127. *See* Clare, *supra* note 15, at 16; Anonymous Source, Personal Communications (Nov. 15, 2022) (discussing the need to reinforce older landing stations).

128. *See* Working Group 8, *supra* note 70, at 20.

129. *See* Peter Dockrill, *Critical Parts of the Internet Never Designed to Be Underwater Will Drown in a Few Years*, ScienceAlert (Jul. 17, 2018), https://www.sciencealert.com/critical-parts-internet-never-designed-to-be-underwater-cables-fibre-optic-data [https://perma.cc/53M5-C8W6].

130. *See, e.g.*, Clare, *supra* note 15.

131. Int'l Cable Protection Comm., *Statement at 21st Meeting of Informal Consultative Process on Sea-Level Rise and Its Impacts* (2021), https://www.un.org/depts/los/consultative_process/icp21/ICP21_item%203_ICPC_English.pdf [https://perma.cc/96BC-WQE7].

132. *See* Kevin Frazier, *Policy Proposals for the United States to Protect the Undersea Cable System*, 13 J. L., Tech. & Internet 1, 25 (2022); Anonymous Source, Personal Communications (Nov. 15, 2022) (providing the precise figure as to the number of federal and state-level bodies that have jurisdiction over the subsea cable infrastructure).

133. *See id*.

134. Anonymous Source, Personal Communications (Nov. 15, 2022).

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