Towards resilient and sustainable infrastructure:

A case study of Governance of Critical Infrastructure Resilience in Costa Rica

This case study contributes insights into Costa Rica's policies and practices aimed at ensuring its critical infrastructure is more resilient against future disasters. It provides an overview of Costa Rica's capacity and progress in assessing the vulnerability and criticality of its infrastructure. It also analyses governance and finance arrangements for critical infrastructure resilience, highlighting good practices and identifying bottlenecks.

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Executive Summary

Critical infrastructure resilience is an essential for Costa Rica's national resilience and continued sustainable development. National resilience entails the ability to prepare and plan for, absorb, recover from, and more successfully adapt to major adverse events and disasters. Costa Rica's high exposure to a wide range of natural hazards threatens critical infrastructure across the country. Disruptions in critical infrastructure can have cascading impacts that resonate far beyond the affected area, impeding disaster recovery efforts, at worst hampering long-term sustainable development and driving inequalities.

Key Findings

Costa Rica has made substantial investments in emergency preparedness and disaster management capacities at critical infrastructure level. At the national level, various policies stress the value of critical infrastructure resilience, contributing to the uptake of resilience measures at operator level. Many operators have started to implement comprehensive resilience measures, and some showcase exemplary resilience efforts. When operators experience disaster-related damages, the National Emergency Fund may be tapped upon, and hazard insurance is available.

At the same time, a number of challenges and governance gaps persist in Costa Rica, calling for further strengthening of critical infrastructure resilience efforts. The existing policies are not sufficiently detailed and do not build on a common national criticality and interdependence assessment that could help operators prioritize investments into resilience. Access to the National Emergency Fund is not tied to *ex ante* resilience measures taken, nor to whether an asset has been damaged for the first, or for the umpteen time, skewing incentives for investing in resilience. Accountability frameworks leave room for reinforcement, and cross-sectoral cooperation and information-sharing is not developed and far-reaching enough to create peer pressure and a common sense of responsibility that ensures optimal investments in resilience. As a result, substantial resilience disparities exist between sectors, with some sectors' resilience lagging far behind.

National resilience entails the ability to prepare and plan for, absorb, recover from, and more successfully adapt to major adverse events and disasters.

Recommendations

1. Launch a standardized national criticality and interdependence assessment for critical infrastructure:

- Set up a national criticality and interdependence assessment that builds on assessments at operator level, safeguarded by confidentiality requirements and security protocols.
- Establish central responsibility to lead the national criticality assessment, ensure compatibility between operator assessments, bring results together, and expand and analyse them in light of systemic interdependencies and needs.
- Coordinate the national criticality assessment with operators and other pertinent stakeholders, and incorporate their technical expertise and analyses into the systemic analyses.
- Develop a common critical assets inventory, classifying assets by their criticality in the national context. Maps that illustrate interdependencies would be a useful complement.
- Share assessment results to relevant representatives from operators and the government, protected by strong safeguards and security protocols.

2. Adopt a national critical infrastructure resilience strategy offering comprehensive policy guidance for all stakeholders:

- Adopt a comprehensive national critical infrastructure resilience strategy that defines clear objectives and promotes an all-hazards approach, building on the standardized national criticality and interdependence assessment.
- Design a complementary action plan that sets out action items for the strategic objectives and timelines for their implementation.
- Ensure broad stakeholder consultations with operators, regulatory authorities and line ministries and other relevant actors under the National Risk Management System, in the design of the national strategy and action plan.

3. Ensure effective incentives for investing in ex ante resilience measures at operator-level:

- Use the National Emergency Fund to create incentives for carrying out resilience measures: Align size of recovery payments with implementation of *ex ante* measures and introduce requirements to use recovery funding to build back better.
- Establish provisions, including fines or corrective measures applicable in cases of non-compliance with the resilience requirements outlined in the relevant policies.

4. Establish accountability frameworks for consistent implementation of resilience objectives across all critical sectors:

- Foster stronger cooperation between the Emergencies Commission and the Comptroller General to ensure seamless cooperation through clear and binding agreements.
- Strengthen oversight responsibilities at central government level, with a shared role for the National Emergencies Commission (CNE) and the Comptroller General of the Republic (CFR), with CFR well-placed to conduct inspections as part of its auditing function, and the CNE well-placed to keep track of non-compliance cases, and ensure joint follow up corrective action.

5. Boost information-sharing and partnerships across stakeholders, building on the availability of disaster risk assessments:

- Create a cross-sectoral critical infrastructure platform that brings all relevant representatives from operators and the government together.
- Establish a central government lead to manage the platform, and organise regular meetings. In light of its technical expertise, and experience in coordinating the National Risk Management System, the National Emergencies Commission would be well placed to take this role.
- Give the following responsibilities to the cross-sectoral critical infrastructure platform: (i) coordinate resilience measures and actions; (ii) exchange relevant security information and subject-matter expertise; (iii) lessons learning following disruptions; (iv) develop mutual assistance agreements, including sharing of equipment and emergency stocks, and joint exercises.
- Establish agreements that address data protection and competition questions as legal basis for the partnership between operators and the government.

6. Ensure financing arrangements to increase resilience of critical infrastructure:

- Consider creating a critical infrastructure resilience fund to support operators with partial financial support for *ex ante* disaster risk management measures. Fines for non-compliance with resilience requirements could provide funding, while national criticality assessments should help prioritise funding decisions.
- Improve the affordability of effective insurance cover, making uptake more attractive to operators. The catastrophe risk transfer vehicle (CRTV) is a good step in this direction.

Introduction

The effective functioning of critical infrastructure is an essential component of socio-economic well-being, sustainable development and inclusive growth. Disruptive events and failures in critical infrastructure systems such as water, electricity or telecommunication services can have widespread negative impacts on communities; disrupt economic activity affecting local, regional or even national economies in the short and long term. Critical infrastructure failures can therefore reinforce the spreading of negative impacts of disasters and hamper a country's long-term sustainable development objectives.

Costa Rica's geographic location between the Caribbean Sea and the Pacific, along two tectonic plates exposes it to both geophysical and climate-related hazards. As a result, more than two thirds of Costa Rica's population and GDP are located in areas characterized by multi-hazard exposure. Critical infrastructure is no exception in this regard, facing a wide array of hazards, ranging from climate-related hazards, such as storms and torrential rain to geophysical ones, including volcanic activity and earthquakes.

Governments have a key role in promoting the resilience of critical infrastructure. Government is responsible for designing legal frameworks and policies that encourage investments in resilience measures by operators and provide deterrent mechanisms for cases of non-compliance. In addition, with most of its critical infrastructure publically owned, the Costa Rican government has immediate responsibility for ensuring the continuity of critical infrastructure in the face of hazards.

Costa Rica has made substantial investments in emergency preparedness and management capacities in recent years and has started to recognise the importance of resilience of its critical infrastructure. This report assesses Costa Rica's progress and achievements, but also the bottlenecks prevailing in attaining and sustaining critical infrastructure resilience. Particular emphasis is made on governance mechanisms and institutional design for critical infrastructure resilience in Costa Rica. Governance arrangements can significantly facilitate or hamper the effective engagement and investment of governmental and non-governmental stakeholders in ensuring critical infrastructure resilience against disasters.

More than two thirds of Costa Rica's population and GDP are located in areas characterized by multi-hazard exposure.

This case study contributes insights into Costa Rica's policies and practices established in support of its efforts to make critical infrastructure more resilient against future disasters. It provides an overview of Costa Rica's capacity and progress in assessing the vulnerability and criticality of its infrastructure assets. It also analyses Costa Rica's governance and financing arrangements for critical infrastructure resilience, highlighting good practices and identifying potential bottlenecks.

This study builds on previous work by the OECD and the IDB (Fisher and Gamper, 2017) that sought to identify effective ways for countries to boost their infrastructures' resilience against disasters. A policy evaluation framework was developed for that purpose. The framework builds on relevant OECD guidance in this area, including the OECD *Recommendation on the Governance of Critical Risks* (OECD, 2014b) and the OECD *Recommendation on Disaster Risk Financing Strategies* (OECD, 2017). It identifies the main governance mechanisms underpinning critical infrastructure resilience, and gives additional information on the application of the principles found therein to managing risks threatening critical infrastructure systems.

The information presented in this case study draws on Costa Rica's response to an OECD questionnaire, complemented by desk research and a fact finding mission to Costa Rica, carried out in January 2018.

The first chapter of this case study provides an overview of Costa Rica's multi-hazard and disaster risk exposure, as well as the socio-economic impact of past disasters in the country. It then provides a snapshot of instances, where disasters have caused significant damage and disruptions to critical infrastructure in Costa Rica. The second chapter takes stock of Costa Rica's efforts towards resilient critical infrastructure systems and assesses good practices and potential areas for improvement. It shows that some of Costa Rica's critical infrastructure operators have achieved a level of maturity in their resilience that is as an exemplar for the region, encouraged by the resilience objectives outlined in various applicable policies and laws. However, substantial resilience disparities exist between sectors. Given that most critical infrastructure rely on other sectors, the system as a whole ends up being as fragile as its weakest link; leaving room for further bolstering of critical infrastructure resilience.

1. Costa Rica's wide range of natural hazards threatening critical infrastructure

1.1. Hazard sources and disaster risk exposure

Located between the Caribbean Sea and the North Pacific Ocean, bordering the Pacific Ring of Fire and divided by a mountain range in its centre, Costa Rica is exposed to a wide range of natural hazards, ranging from geophysical hazards to weather-related hazards (Table 1.1).

When hazards disrupt the provision of critical infrastructure, cascading impacts that disturb the well-being of Costa Rican society beyond the hazardous event can follow. At worst, critical infrastructure failures reinforce the spreading of negative impacts of disasters to an extent that hampers sustainable development and drives inequalities (United Nations, 2016).

Seismic hazards, such as earthquakes, volcanic activity and tsunamis, as well as landslides have been identified as critical hazards threatening critical infrastructure in Costa Rica. Among hydro-meteorological hazards, which accounted for a large portion of critical infrastructure disruptions registered in the past decade, hurricanes and floods have been identified as a major hazard for critical infrastructure in Costa Rica. The Costa Rican authorities also identified fires as well as spills of toxic substances, which may occur following an industrial accident or when a natural hazard triggered a technological disaster (Natech), as a major hazard linked with the disruption of critical infrastructure.

Table 1.1. Types of natural hazards prevalent in Costa Rica

Natural hazard category	Types of natural hazards
Geophysical	Earthquakes, volcanic activity
Hydrological	Floods
Meteorological	Tropical storm and hurricanes
Climatological	Droughts

Source: GFDRR, 2010; response to the 2017 questionnaire on the governance of critical infrastructure resilience in Costa Rica.

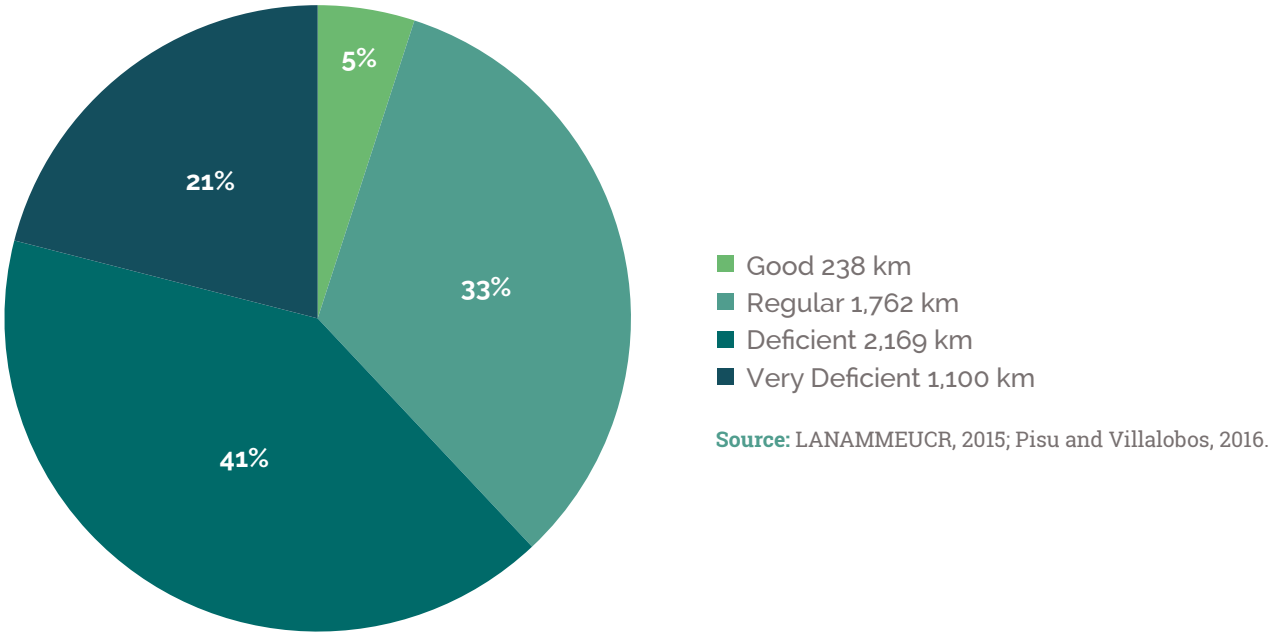
Around 36.8 percent of Costa Rica's landmass is exposed to three or more natural hazards and an estimated 80 percent of the country's population, assets and GDP are located in areas exposed to multiple hazards. The high population density and asset concentration in the Central Valley generates additional vulnerabilities (Figure 1.1). The capital San José, located at the heart of the Central Valley, is exposed to high risk of droughts, earthquakes, floods, landslides and volcanic activity, as well as to medium cyclone risk (UN DESA, 2015).

The ageing state of some of Costa Rica's critical infrastructure may increase underlying vulnerabilities. An evaluation by the National Laboratory of Materials and Structural Models of the University of Costa Rica (*Laboratorio Nacional de Materiales y Modelos Estructurales*, LANAMMEUCR), for instance, showed that the extensive Costa Rican road network is of relatively poor quality, with about 62 percent of roads evaluated as in deficient or very deficient conditions and none in very good condition (Figure 1.2). Many bridges have been judged at structural risk of collapsing due to deterioration, with poor maintenance compounding the situation (LANAMMEUCR, 2015). Both tropical Storm Tomas that hit Costa Rica in late 2010 and Hurricanes Otto and Nate that moved over Costa Rica in late fall 2016 and 2017 caused widespread damage to roads and bridges that resulted in traffic interruptions of more than 15 days. Even short-lived disruptions in transportation networks may result in significant cascading effects, caused e.g. by the delay in movement of both people and goods (World Bank, 2012; Reliefweb, 2016).

Figure 1.1. Value and distribution of buildings at risk from earthquakes and hurricanes in Costa Rica

Source: GFDRR, 2016.

Figure 1.2. Functional conditions of national paved roads in Costa Rica



Source: LANAMMEUCR, 2015; Pisu and Villalobos, 2016.

Increasing climate variability linked to the effects of climate change is expected to exacerbate weather hazards in the region. Records show that over the past decades temperature has increased between 0.2 and 0.3 ˚C in Costa Rica. The temperature increases are expected to trigger more frequent and extreme weather events, such as droughts and storms as well as more intense precipitation per episode. Costa Rica's Caribbean coast is expected to experience the most severe storms and floods, while the Northwest is projected to experience the most pronounced droughts. Among other things, this creates a stressor for the availability and provision of water, a critical input factor for economic productivity and livelihoods. During El Niño years, weather hazards are already more pronounced, with frequent severe droughts resulting from it on the Pacific coast of Costa Rica, and intense rains that cause flooding on central Costa Rica's Caribbean slope (UNDP, 2017; Economic Commission for Latin America and the Caribbean, 2015).

The tight interconnection of grids across six Central American countries, resulting from the integration of electricity systems through the Central American Electrical Interconnection System (*Sistema de Interconexión Eléctrica de los Países de América Central*, SIEPAC), makes the Costa Rican grid vulnerable to cross-border disruptions. Power outages can have major impacts on economic activity and thus result in significant economic damages beyond the direct damage caused to the grid. In July 2017, for instance, heavy rain in Panama caused the failure to the shared Central American transmission line (SIEPAC), which left up to 1.4 million homes and businesses across Costa Rica without power for five hours. As a result many businesses had to close and transport was disrupted (Tico Times, 2017a). Resilience measures implemented by the ICE Group contributed to a comparatively shorter outage in Costa Rica, while neighbouring countries were off the grid for much longer.

1.2. Socio-economic impacts of past disasters

Data collected by the Ministry of National Planning and Economic Policy (*Ministerio de Planificación Nacional y Politica Económica*, MIDEPLAN) show that in the past four decades, earthquakes, hurricanes and floods have been the most impactful hazards in Costa Rica (see Table 1.1 and Figure 1.2).

Some of the most impactful disasters were the Limon earthquake in 1991, which resulted in an estimated damage of USD 444 million, and the even more impactful Cinchona earthquake in 2009 that caused ca. USD 678 million in damages and killed thirty-one people. Hurricanes, too, have caused very high costs in recent years. Hurricane Tomas that struck Costa Rica in 2010 USD 354 million in damages, killing twenty-four people, and hurricane Otto in 2016 caused damages summing up to USD 199 million, and causing fifty deaths. The most recent storm Nate killed at least eight and left widespread damage in its wake (MIDEPLAN, 2015).

On average, the damages caused by disasters between 1995 and 2016 have summed up to 0.16 percent of annual GDP, ranking Costa Rica slightly above OECD average that stands at 0.13 percent for the same period (Figure 1.3). The damages from some major disasters, such as the Cinchona earthquake or hurricane Cesar, however, much exceeded this annual average (Figure 1.2).

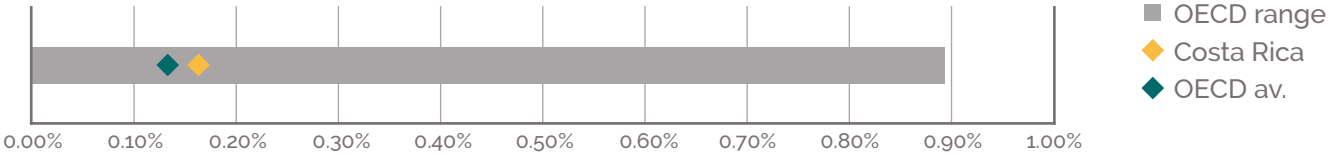
Table 1.2. Major Disasters in Costa Rica since 1990

	Year	People affected	Deaths	Estimated damage (in constant US dollars, 2015)	% of GDP
Cinchona earthquake	2009	128,618	31	678 million	2.22
Limon earthquake	1991	n/a	n/a	444 million	6.19
Hurricane Tomas	2010	3,000	24	315 million	0.85
Hurricane Cesar	1996	500,000	50	216 million	1.86
Hurricane Otto	2016	50,000	9	199 million	0.35
Tropical Storm Nate	2017	11,517	14	593 million	1.00

Note: Data for tropical storm Nate is still preliminary.

Source: EM-DAT, 2017; MIDEPLAN, 2014; response to the 2017 questionnaire on the governance of critical infrastructure resilience in Costa Rica; World Bank, 2016.

Figure 1.3. Average annual damage of disaster in Costa Rica in % of GDP, 1995-2015



Source: EM-DAT, 2017; World Bank, 2016; OECD Survey on the Governance of Critical Risks.

1.3. The impact of past disasters on Costa Rica's critical infrastructure

Due to the interdependent nature of critical infrastructure, disruptions in critical assets can cause cascading impacts up until system failure. During emergencies, disruptions in critical infrastructure can hinder response efforts. For instance, if a disaster damages critical points of the electricity grid, a country-wide electrical power failure may follow. The high dependence of telecommunications and public health infrastructure on electricity may cause disruptions in the provision of these two services, which in turn may impede emergency response efforts in the affected area. At the same time, other services that rely on electricity, telecommunications or public health infrastructure may no longer be able to provide their services as a result of the disruptions earlier on in the chain (NIST, 2016; Fisher and Gamper, 2017).

Costa Rica demonstrates high technical expertise within its critical infrastructure, but there are instances when disasters have exceeded capacities in the past, resulting in service disruptions. Examples from the past decade include the 2009 Cinchona earthquake that had its epicentre at ca. 35 km from the capital city of San José, and hurricanes Otto and Nate that struck Costa Rica's northern half in late 2016 and late 2017 respectively.

The 2009 Cinchona earthquake caused a number of landslides and mud flows that resulted in substantial damage to transport infrastructure. Media reports suggest that twenty five major roads were blocked and five bridges collapsed. Transportation networks were further impacted as more than 3 km of route 126, a national road that connects the capital San José with the Caribbean coast, were destroyed. The damages to road infrastructure cut communities off from supply routes and interfered with rescue efforts in the affected areas. Damages to water

Table 1.3. Impact of hazardous events on infrastructure, services and production, 2005-2016

Sectors			Damage in USD*	% of damage
Road Infrastructure	Road network	504,023,045		
	Bridges	265,279,353	831,454,900	51.83
	Sewer systems & fords	62,152,502		
Power Systems (seismic event)			495,124,461	30.9
Initial impacts (Immediate investments in vital services)			70,262,919	4.4
Structural measures			65,138,039	4
Public facilities			61,001,882	3.8
Education centres			33,681,333	2.1
Water facilities			22,916,104	1.4
Airports			17,260,658	1.08
Social services			3,911,368	0.2
Railroads			2,712,299	0.17
Information communication technology (ICT)			561,807	0.04
Energy (Pipelines)			276,560	0.02

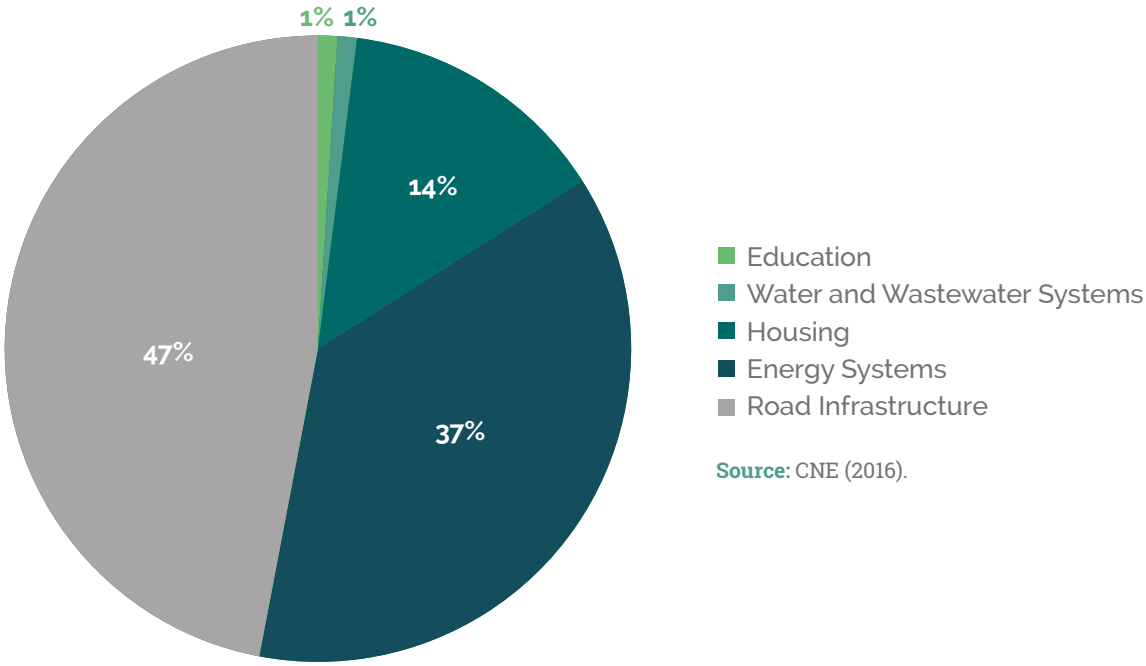
Note: *Values are based on 2015 estimates using the average 2015 Monex exchange rate

Source: Picado, C. and Vallejo, MG, National Commission for Risk Prevention and Emergency Response (CNE) (2017); response to the 2017 questionnaire on the governance of critical infrastructure resilience in Costa Rica.

and sewage systems had significant impacts on the availability of clean water. Mudflows following the earthquake destroyed the Cariblanco Power Generating Station in Sarapiquí de Alajuela, one of Costa Rica's main hydroelectric plants at an electricity generation of 100MW. The plant that represented 10 percent of the Costa Rica's entire energy production capacity was off the grid for five months until it resumed operations at 60 percent capacity in May 2009, hampering electricity supply beyond the directly affected region (IFRC, 2009; EERI, 2009; La Nación, 2009).

Hurricane Otto, which struck Costa Rica in late 2016, damaged nearly 3000 km of roads, with media reporting nearly USD 9 million in road damages (La Nación, 2016). Disruptions in telecommunication services and electricity provisions were mostly limited to the first 48h following the storm, but nonetheless affected business continuity and well-being beyond the affected area (IFRC, 2016). Just one year later, hurricane Nate left substantial destruction in its wake. The transport sector was further damaged, with at least 42 bridges and 499 road sections sustaining substantial damages. The Inter-American Highway also suffered various degrees of damage at over one hundred sites, ranging from superficial cracks to total structural failures. Repairs to road infrastructure are expected to take years, and will require substantial financial resources (La Nación, 2017b). In addition, hurricane Nate damaged nearly 350 educational facilities. The damages to water systems and 198 small local aqueducts disrupted water and sewage systems for a large proportion of the population, with media reports suggesting that nearly half a million people were left without access to clean water for days following the storm. In addition, damages to the electric grid and disruptions to power generation plants left households cut off from electricity across the country, and caused widespread disruptions to telecommunication services (UCR, 2017; El País, 2017; Crhoy, 2017; La Nación, 2017a).

Figure 1.4. Damage distribution by infrastructure sectors, 2005-2011



Source: CNE (2016).

Data from the National Emergency Commission (*Comisión Nacional de Prevención de Riesgos y Atención de Emergencias*, CNE) and MIDEPLAN show that the majority of critical infrastructure disruptions in Costa Rica may be attributed to natural hazards, amounting to an annual average loss of USD 199 million between 2005 and 2016 (Table 1.3). In line with the predominantly public ownership of critical infrastructure in Costa Rica the vast majority (86%) of infrastructure damage affected publicly owned critical infrastructure (Figure 1.4). The remaining damages were incurred in the housing sector (CNE, 2016; MIDEPLAN, 2015).

In some cases, the lessons learned from disruptions to critical infrastructure systems have translated into policy changes. For instance, as a result of previous experience with disaster-related disruptions to electricity generating infrastructure, the operator Costa Rican Institute for Electricity (*Instituto Costarricense de Electricidad*, ICE), implemented a comprehensive hazard insurance strategy. The pay-out following the 2009 Cinchona earthquake that damaged the Cariblanco hydroelectric dam contributed to its speedy recovery and thus prevented long-term energy supply disruptions. The recovery from the 2012 Sámara earthquake is another example for how infrastructure operators draw lessons from critical infrastructure failures. Rather than replicating resilience gaps, operators prioritized to rebuild in a way that makes future failures less likely. Following Hurricane Otto that struck Costa Rica in 2016 and left substantial damages in its wake the government started to set up a series of incentives for resilient recovery of small and medium-sized businesses. Following a devastating fire in one of its hospitals, the Costa Rican Department of Social Security (*Caja Costarricense de Seguro Social*, CCSS) created the "Safe Hospital" programme (*Política Institucional de Hospital Seguro*) in 2006. The programme outlines provisions for increasing the resilience of its infrastructure, including considerations for redundancies in case of supply chain disruptions.


Via

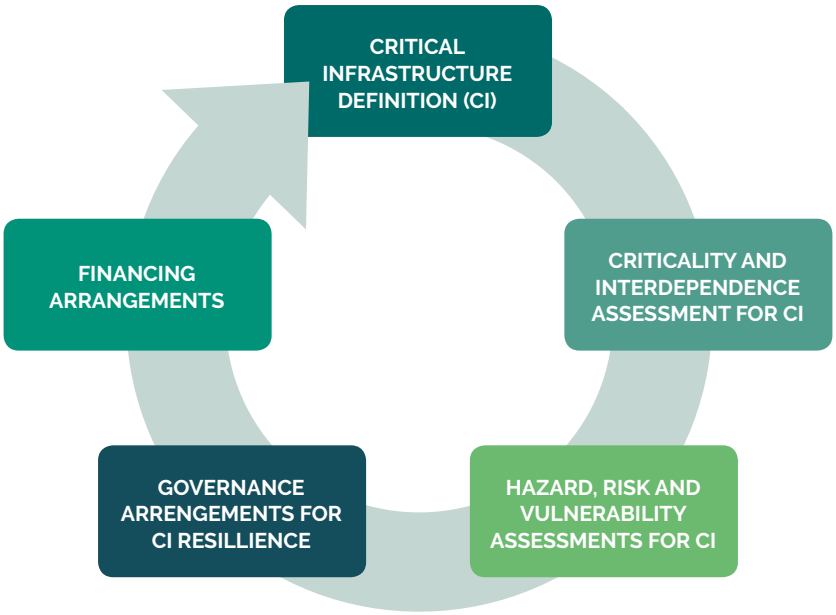
2. Defining, identifying and managing critical infrastructure resilience in Costa Rica

The above sections have provided a rationale for the need to address critical infrastructure resilience to minimise the spreading and the prolongation of negative impacts of disasters and to ensure the well-being of a society and its economy.

This section evaluates the progress and achievements of Costa Rica in identifying critical infrastructure and ensuring its resilience. The focus on resilience widens the view beyond the protection of the physical or intangible assets, production systems and networks that make up this infrastructure, to one that also includes the capacity to retain functions in the face of a disruptive shock (OECD, 2014a).

Following the steps outlined in the policy framework developed by the OECD and the IDB (Fisher and Gamper, 2017), this section provides an overview of the governance of critical infrastructure in Costa Rica. Figure 2.1 illustrates the steps that the framework distinguishes for reviewing a country's approach to governing critical infrastructure resilience.

Figure 2.1. OECD/IDB Critical Infrastructure Resilience Framework



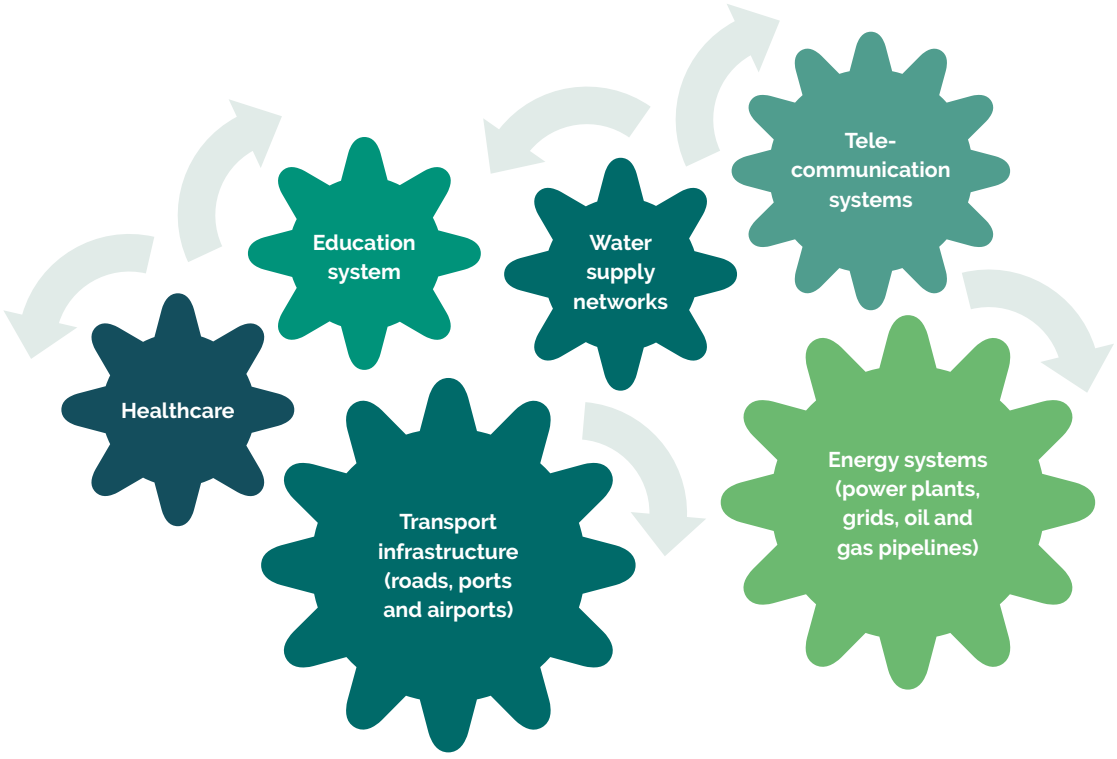
Source: Fisher and Gamper (2017).

2.1. Defining critical infrastructure

The definition of critical infrastructure is the foundation for knowing what exactly needs to be managed and how. Ideally, the definition has evolved over time, taking the dynamics influencing the concept in the short and longer runs into account (e.g. the growing reliance on information technology). The definition of what actually falls under "critical infrastructure" can vary quite considerably across countries. Depending on the country context, the definition of sectors as critical infrastructure can be narrow and include only water, energy, transportation and telecommunication or can be broad and also include government, healthcare, banking and finance, emergency services and so on (Fisher and Gamper, 2017). Their criticality derives from their key role in enabling the smooth flow of everyday life, from social well-being over economic productivity to public safety and security. Often, these systems are also closely interdependent on each other, which may result in cascading effects in case of disruption to one chain link (Gordon and Dion, 2008).

In Costa Rica, the National Law 8488 on Emergencies and Risk Prevention (*Ley Nacional de Emergencias y Prevención de Riesgos*, No. 8488) provides the framework for the country's disaster risk management policy. The law identifies water and sewage networks, telecommunication systems, energy systems (power plants and grids as well as oil and gas pipelines), transport infrastructure (including roads, ports and airports) and healthcare as vital facilities (Law 8488 Art. 30b). In addition, in their response to the OECD Survey on the Governance of Critical Infrastructure the authorities also listed the education system as vital facility (Figure 2.2).

Figure 2.2. Critical infrastructure sectors in Costa Rica

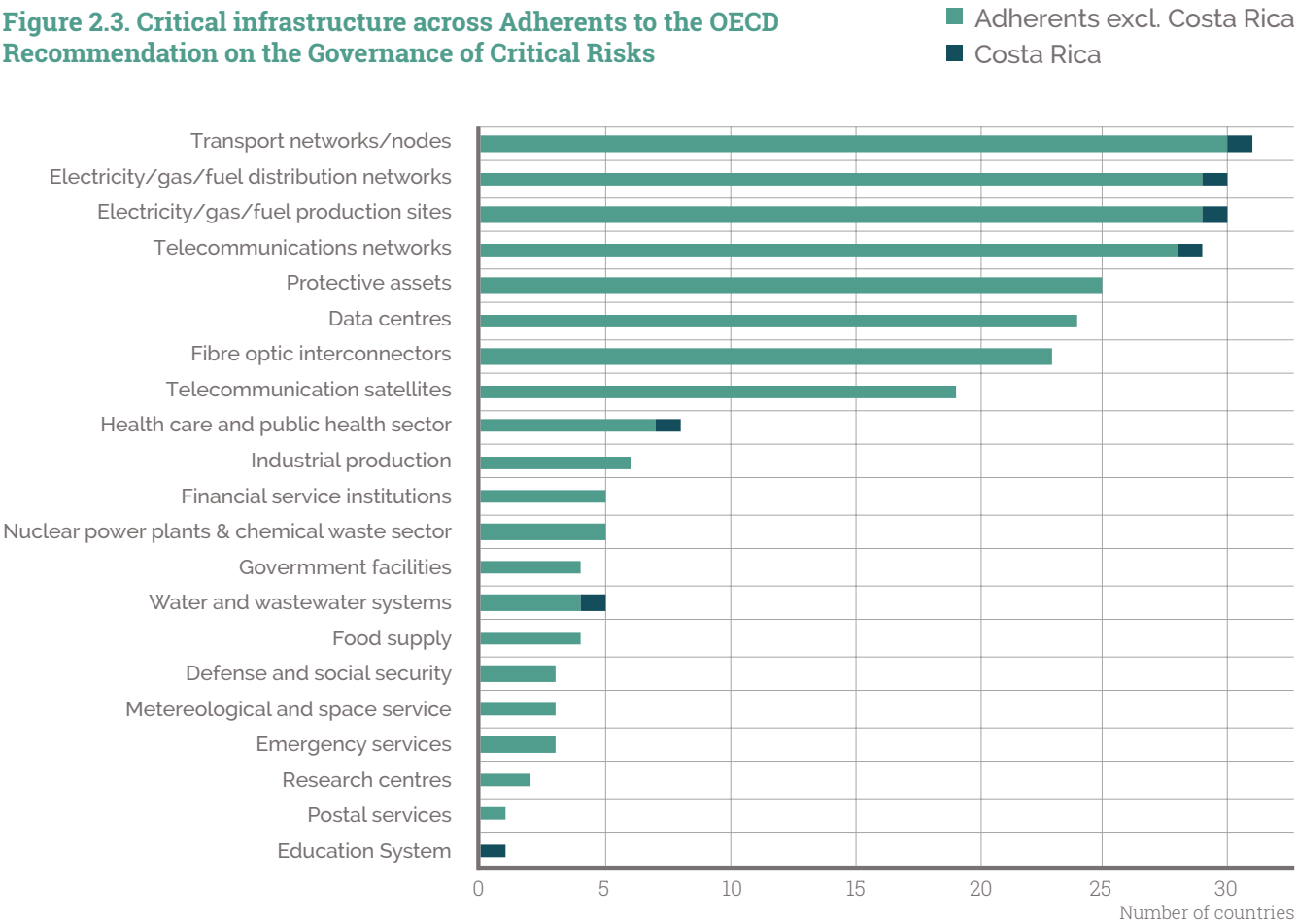


Source: Based on National Law 8488 on Emergencies and Risk Prevention; Response to the 2017 OECD Survey on the Governance of Critical Infrastructure.

Aside from the designation of the education system as critical infrastructure, the sectors identified as vital facilities in Costa Rica largely correspond to the sectors identified as critical infrastructure across OECD countries. Nonetheless, some sectors designated critical in most OECD countries (e.g. protective assets, data centres, fibre optic interconnectors and telecommunication satellites) are not designated as such in Costa Rica, corresponding to the more localized perspective suggested by the vital facilities angle. Figure 2.3 provides an overview of sectors identified as critical in Costa Rica and in countries adhering to the OECD Recommendation on the Governance of Critical Risks (OECD, *forthcoming a*).

Adherents from the Latin America and Caribbean region designated similar sectors as critical infrastructure as the majority of Adherents to the OECD Recommendation. In Mexico, for instance, like in Costa Rica, transportation networks, energy production and distribution networks and telecommunication networks were identified as critical infrastructure, but unlike in Costa Rica telecommunication satellites, fibre optic interconnectors, data centres and protective assets were also identified. In Chile on the other hand only transportation networks, telecommunication networks and energy production and grids, as well as protective assets have been identified as critical infrastructure (OECD, *forthcoming a*).

Figure 2.3. Critical infrastructure across Adherents to the OECD Recommendation on the Governance of Critical Risks



Note: Answers received: 30 out of 34 responding Adherents.
Source: OECD Survey on the Governance of Critical Risks.

Stakeholders underlined that in Costa Rica, coining critical infrastructure as vital facilities suggests a focus on assets and services needed to recover quickly following a hazardous event rather than on interconnected systems underpinning the socio-economic well-being of the entire country. While the sectors designated as vital facilities correspond largely to infrastructure termed critical in other countries, viewing them as vital facilities takes a more localized view rather than the broader systems angle underpinning the critical infrastructure perspective. Stakeholders identified this bounded view as a limiting factor in upscaling the attention paid to the resilience of critical infrastructure in Costa Rica as a whole.

The IDB Index of Governance and Public Policy in Disaster Risk Management (iGOPP) shows that in many countries across Latin America this (bounded) perspective is more prevalent. The iGOPP also shows that definitions of critical infrastructure across the region often focus on infrastructure assets rather than systems or networks. In Panama, for instance, Structural Design Regulations designate buildings and other structures, whose absence or failure would cause a significant threat to human life, as vital or indispensable facilities. In Colombia, Law 400 of 1997 specified by Decree No. 926 of 2010, highlights buildings that provide community support and should operate during and after a disaster (e.g. schools and hospitals) as indispensable facilities (IDB, 2015).

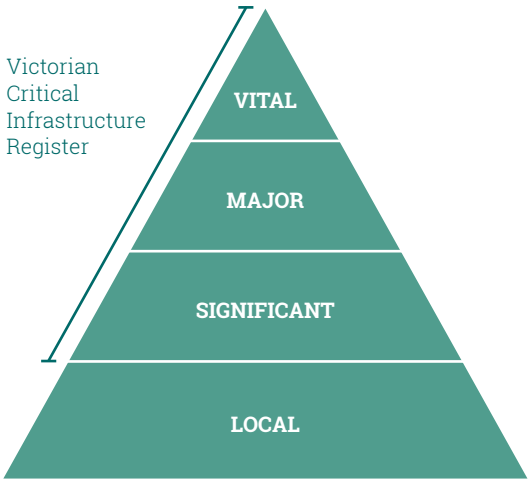
Conclusion

Costa Rica identifies many of the same sectors as critical infrastructure as OECD countries: water supply, telecommunication, energy, transport and healthcare system, as well as education facilities. However, terming critical infrastructure as vital facilities suggests a different perspective than that prevalent in OECD countries: In Costa Rica, and other countries across Latin America, the understanding is localized, highlighting assets and services needed to recover quickly following a hazardous event, while across the OECD a broader systems perspective that considers interdependencies prevails. Costa Rica's more bounded perspective jeopardizes taking the interdependences and potential cascading effects affecting the country's overall well-being, into account.

Box 2.1. Assessing Criticality of Critical Infrastructure in Australia

In the Australian state of Victoria, critical infrastructure is classified by four levels of criticality (Figure 1). The classification of infrastructure that has been previously identified as critical follows a standardised criticality assessment methodology, the Victorian Criticality Assessment Tool (viccat).

CRITICAL INFRASTRUCTURE CRITICALITY PYRAMID FOR VICTORIA



VITAL critical infrastructure that is of State significance and is critical to the continuity of supply of essential services to the State and to the overall economic and social well-being of Victorians.

MAJOR infrastructure that is critical to the continuity of supply of essential services to more than one region, or to the overall economies and social well-being of those regions.

SIGNIFICANT infrastructure that is critical to the continuity of supply of essential services to a region or to the overall economic and social well-being of that region.

LOCAL infrastructure that is critical to the continuity of supply of essential services to a community or to the overall economic and social well-being of that community.

Source: Victoria, Australia State Government (2015)

2.2. Criticality and interdependence assessments

The definition of critical infrastructure should be based on criticality assessments to identify those assets, systems, and networks that are truly critical to a country's socio-economic well-being. While certain infrastructure sectors as a whole have a critical role for the functioning and well-being of societies, not all elements making up these sectors necessarily have the same level of criticality. Criticality assessments enable an identification and prioritisation of those assets, systems, and networks that are truly critical and usually result in the development of inventories or databanks that rank infrastructure by criticality or maps that feature critical infrastructure. As different stakeholders may have different views and interpretations of what constitutes criticality, clear communication and exchange between operators and the government in this regard is crucial. Ideally, all stakeholders cooperate to develop lists of critical infrastructure, considering potential socio-economic impacts in terms of jurisdictions affected and duration of the disruption (Zaballos and Juen, 2016, OECD, *forthcoming b*).

Criticality assessments are underpinned by analyses of interdependences across critical infrastructure systems that may cause cascading impacts when disturbed or damaged. In some cases, critical infrastructure service provision is so interwoven that the disruption of one service leads to the disruption other services, which then may even compound recovery of the initially disrupted service. These interdependences can be physical, but may also be technical or organisational. In some cases, interdependences may be hidden, e.g. indirect dependencies resulting from the interactions of many intermediate sectors throughout the supply chain (Rinaldi et al., 2001; Fisher and Gamper, 2017).

In Costa Rica, infrastructure sectors of critical importance are listed in Law 8488 (see above), but no systematic country-wide or sectoral criticality

assessment classifying each sector listed therein or the individual assets making up these sectors by criticality is in place. Similarly, the Costa Rican government does not carry out interdependence assessments for critical infrastructure, and does not maintain a critical assets inventory.

Some of the larger public infrastructure operators, such as the Costa Rican Institute for Electricity Group (*Grupo Instituto Costarricense de Electricidad*, ICE Group) and the Costa Rican Department of Social Security (*Caja Costarricense de Seguro Social*, CCSS) have started to conduct their own criticality evaluations, which sometimes include interdependence assessments (see Box 2.3). For the ICE, a specific corporate committee assesses the criticality of its infrastructure, and prioritizes assets to concentrate resilience efforts, illustrating the senior level buy-in for resilience considerations. Given its high dependence on the effective functioning of other critical services, the CCSS identifies weak points along its supply chain, and uses the information to design apt business continuity plans. While operator-level assessments are valuable, they cannot fully replace a national criticality assessment that takes a whole-of-society perspective, considering critical infrastructure interdependences and wider supply chain dependencies.

On the other hand, a common national criticality assessment would help operators better prioritize resilience measures in line with overarching socio-economic exigencies, including other operators' dependencies. Critical infrastructure sectors where maintenance and retrofitting are very cost-intensive or where finance depends largely on public coffers, could particularly benefit from such an overview at central-level, as it enables operators to focus their resilience efforts where the impact of interventions is largest.

In a number of OECD countries, such as Australia (Box 2.1), Switzerland and the Netherlands, assess and classify the criticality of assets, systems and networks in a systematic manner and track them in national registries (Fisher and

The viccat tool follows an all hazards approach and includes both narrative inputs and metrics aligned to the National Emergency Risk Assessment Guidelines. The vulnerabilities of upstream and downstream dependencies, as well as the resilience of critical infrastructure, are included. The input from operators and the results from dialogues between government and operators about an individual criticality rating are a key part of the assessment process. On advice of the relevant minister, the final criticality ratings for critical infrastructure are passed.

The results of the criticality assessment are fed into the Victorian Critical Infrastructure Register. In this register, all infrastructures underpinning the well-being of Victoria's economy and society is tracked and organized in line with the four levels of criticality. In addition, the criticality levels determine the disaster risk management measures to be implemented by operators. For instance, owners and operators of infrastructure that is declared as 'vital' are obliged to undertake legislated emergency risk management planning. For infrastructure rated as 'major' and 'significant', industry are encouraged to voluntarily develop best practice standards based on the requirements for 'vital' critical infrastructure.

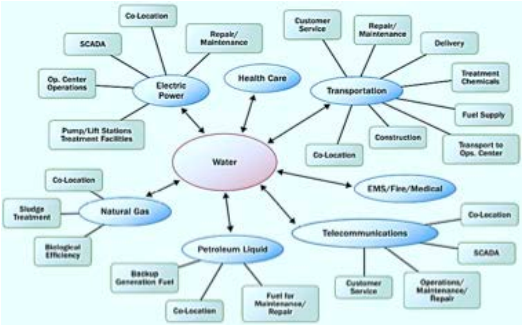
Source: Victoria, Australia State Government (2016); Victoria, Australia State Government (2015)

Box 2.2. Analysing interdependencies between critical infrastructure in the United States

In the United States the Department of Energy has supported research to map interdependencies with electricity infrastructure and potential cascading impacts due to disruptions caused. The research identifies systems vulnerabilities and helps to prioritize measures that address potential failure points that would have the most severe consequences. An interactive map of power plants, pipelines and transmission lines, and energy resources provides a publically accessible illustration of the U.S. energy system.

Similarly, the Department of Homeland Security evaluates the impact of disruptions to water systems by evaluating public health effects, economic costs (lost productivity and infrastructure damage), psychological and governance impacts, as well as interdependencies and dependencies with other infrastructure sectors. Figure 1 illustrates these interdependencies.

INTERDEPENDENCIES OF WATER SYSTEMS WITH OTHER CRITICAL INFRASTRUCTURE



Source: Riedman (2016)

Source: US Energy Information Administration (2017); Department of Homeland Security (2010); Riedman (2016)

Gamper, 2017). A good practice of a comprehensive interdependence analysis can be found in the United States where the Department of Energy and the Department of Homeland Security conduct such analyses for the energy and water sectors (Box 2.2).

Conclusion

While some operators in Costa Rica conduct their own criticality and interdependence assessments, there is no common national criticality assessment, reflecting Costa Rica's vital facilities perspective. Without a national criticality assessment, there is no shared reference point to define what assets, systems and networks are critical for Costa Rica, resulting in different views among operators and the government. In addition, for lack of a common interdependence assessment operators and the government can only have a limited understanding of the systemic interlinkages and dependencies. Considering the cascading effects that may follow a disruption at a critical point, it is important to prioritize resilience measures accordingly. In default of the common criticality and interdependence assessment, Costa Rica also does not maintain a critical assets inventory.

2.3. Disaster risk and vulnerability assessments

Once critical infrastructures have been defined and their criticality assessed, disaster risk and vulnerability assessments constitute the next step towards realizing critical infrastructure resilience. These assessments are key to understand the most important risks and threats facing the infrastructure and to identify weak points where disruptions might occur. The findings of disaster risk and vulnerability assessments also provide the basis to design and carry out appropriate resilience measures. Ideally, risk and vulnerability assessments are carried out at operator-level, following a standardized methodological approach that allows comparing and extrapolating the findings (Fisher and Gamper, 2017).

The National Policy for Risk Management (*Política Nacional de Gestión del Riesgo*) 2016-2030 and the National Development Plan (*Plan Nacional de Desarrollo*) require risk analyses for all new public investments, be they in critical infrastructure or other projects (MIDEPLAN, 2014; CNE, 2016). The Ministry of Planning and Economic Policy (*Ministerio de Planificación Nacional y Política Económica*, MIDEPLAN) created investment manuals that include guidance for hazard and risk assessments, including for potential climate risks. MIDEPLAN guidelines for public investments also include resilience criteria, but their actual integration in the investment decision depends on economic efficiency considerations. In addition, the General Internal Control Law (*Ley de Control Interno*) requires infrastructure providers and enterprises to create their institutional risk assessment systems (*Sistema Específico de Valoración del Riesgo Institucional*, SEVRI) to identify and analyse the risks their operations face.

Most operators in Costa Rica reported that they conduct hazard assessments for their infrastructure. Often, these are carried out in the planning phase for new infrastructure, but some good practices of hazard assessments for present infrastructure exist. The National Road Council (*Consejo Nacional de Vialidad*, CONAVI), for instance, recently launched a hazard assessment for standing road infrastructure under its responsibility, which later on is set to serve as the basis for a road resilience action plan and a national plan for climate-proofing road infrastructure. In some cases, the hazard assessments are also carried out for standing infrastructure, to enable retrofitting of exposed assets. As part of the "Safe Hospital" programme, the CCSS for example calculated the cost of retrofitting and, where needed relocating exposed hospitals. Using the Hospital Safety Index of the Pan American Health Organisation[1], hospitals under CCSS management were prioritized for resilience measures, with the majority of these measures fully implemented since the programme's launch in 2006. Despite such good practices, operators reported that hazard assessments typically are not updated at a later stage, even though changes in the surrounding environment, for instance, may call for it.

In some cases the affordability of data can be a challenge for understanding risks to critical infrastructure. For example, hydro-meteorological datasets necessary for understanding the full extent of critical infrastructure assets' hazard exposure require the end users to buy these from the relevant technical agencies or research institutions. A national system for understanding risks that leverages public and private datasets could be a significant aid for grasping the extent of the exposures and vulnerabilities of critical infrastructure.

[1] http://www.paho.org/disasters/index.php?option=com_content&view=article&id=960:what-is-the-hospital-safety-index&Itemid=1252&lang=en

In addition, in Costa Rica the results of hazard assessments carried out by operators of critical infrastructure are not communicated with other government departments or relevant stakeholders (such as other operators of critical infrastructure that rely on the provision of certain services for their business continuity). This limited exchange of information across operators of critical infrastructure and with the government prevents operators from taking the most effective resilience measures and hinders a collaborative environment. Infrequent dialogue about each other's weak points may also result in vulnerabilities at critical links go unnoticed until disaster strikes, which may compound the disaster's impact across interdependent sectors. Keeping information on vulnerabilities concentrated at operator-level prevents the design of critical infrastructure resilience policies that effectively address these. In addition, the government is less able to provide targeted support for operators, if it is unaware where operators' resilience gaps lie.

While the flow of information from operators to the central government can be complex, in the other direction information flows are smoother. The CNE conducts disaster risk assessments at the national and local level. The results from these assessments, along with information on the exposure to impeding terrorist attacks are communicated to all operators of critical infrastructure in Costa Rica (OECD, *forthcoming a*).

Conclusion

Various Costa Rican policies stipulate disaster risk and hazard assessments as a basis for the design of effective resilience measures. Risk assessments are obligatory for all new public infrastructure investments, and operators are required to create their own institutional risk assessment systems. MIDEPLAN provides technical guidance for this to ensure coherence across investments. Although risk assessments are widely stipulated, most operators reported carrying out hazard assessments for new infrastructure, and sometimes also for standing assets. In addition, the CNE conducts disaster risk assessments at the national and local level.

Despite the availability of hazard and to a certain extent also disaster risk assessments at operator and government level, communication channels for sharing hazard and vulnerability information in Costa Rica could be significantly improved. While the government communicates disaster risk and hazard information to operators, operators tend to keep their information in this regard to themselves. The lack of safeguarded communication channels, e.g. cross-sectoral information exchange and cooperation platforms, and the fees associated with information requests contribute to this.

Sharing risk information with other sectors would enable operators to take into account weak points in each other's respective supply chains, in turn also contributing to the continuity of services they themselves depend on. An exchange of risk information with the government, on the other hand, would enable the design of targeted critical infrastructure resilience policies that consider operators' vulnerabilities and hazard exposure.

2.4. Governance arrangements

Effective governance arrangements are a key element to enabling the resilience of critical infrastructure. It is crucial that roles and responsibilities among all stakeholders, ranging from operators of critical infrastructure to the government, are clearly defined as part of the policy framework underpinning critical infrastructure resilience (Fisher and Gamper, 2017).

2.4.1. Ownership of critical infrastructure in Costa Rica

There are various models for critical infrastructure ownership. While in some countries, most critical infrastructure is owned and operated by national or sub-national level governments, in others the private sector is the operator of the majority of critical infrastructure. Public-Private Partnerships (PPP's) are another model for distributing responsibilities for critical infrastructure operations (Hawkesworth, 2011; OECD, 2015c).

Table 2.1 illustrates that in Costa Rica the vast majority of critical infrastructure is publically operated. Private companies do not play a major role as operators of critical infrastructure in Costa Rica, although some private sector participation is emerging, especially in the telecommunications sector and to a certain extent also in the energy sector. There is a small number of commercially run hospitals, schools and roads.

In the energy sector, the Costa Rican Institute for Electricity Group (*Grupo Instituto Costarricense de Electricidad*, ICE Group) generates the majority of Costa Rica's total electricity supply. Private electricity generation is permitted, but distribution is only possible via the national electricity and telecommunications services provider, the ICE Group. As a consequence, around 80 percent of electricity in Costa Rica is either distributed by ICE or the second subsidiary of the ICE Group, the National Power and Light Company (*Compañía Nacional de Fuerza y Luz*, CNFL). The remaining electricity distribution is managed by municipal companies and co-operatives, such as the Public Services Company of Heredia (*Empresa de Servicios Públicos de Heredia*, ESPH) and the Administrative Board of the Municipal Electric Service of Cartago (*Junta Administrativa del Servicio Eléctrico Municipal de Cartago*, JASEC). The refinery and distribution of wholesale petroleum and its derivatives is managed by the state-owned Costa Rican Petroleum Refinery (*Refinadora Costarricense de Petróleo*, RECOPE) (OECD, 2016a).

In the Costa Rican telecommunications sector the role of private sector engagement is already more pronounced: In addition to the former state monopolist (ICE Group) two private companies provide mobile-phone telecommunication services (Claro Costa Rica CR and *Telefónica de Costa Rica* TC S.A. (Movistar), eleven companies are active in the IP telephony markets and more than twenty provide internet access across Costa Rica (OECD, 2016a; SUTEL, 2016).

In the healthcare sector in Costa Rica, the Costa Rican Department of Social Security (*Caja Costarricense de Seguro Social*, CCSS), an autonomous public institution, operates the majority of hospitals, including three national hospitals, six specialized hospitals, seven regional hospitals and thirteen municipal hospitals. The CCSS also operates the national blood bank (*Banco Nacional de Sangre*) and an ophthalmology clinic. In addition to the hospitals provided by the CCSS, some private hospitals (such as the four largest, Hospital CIMA, *Clínica Biblica*, *Clínica Católica* and *Hospital Clinica* UNIBE, which are all located in the capital San José) and small clinics exist (del Rocío Sáenz et al., 2011).

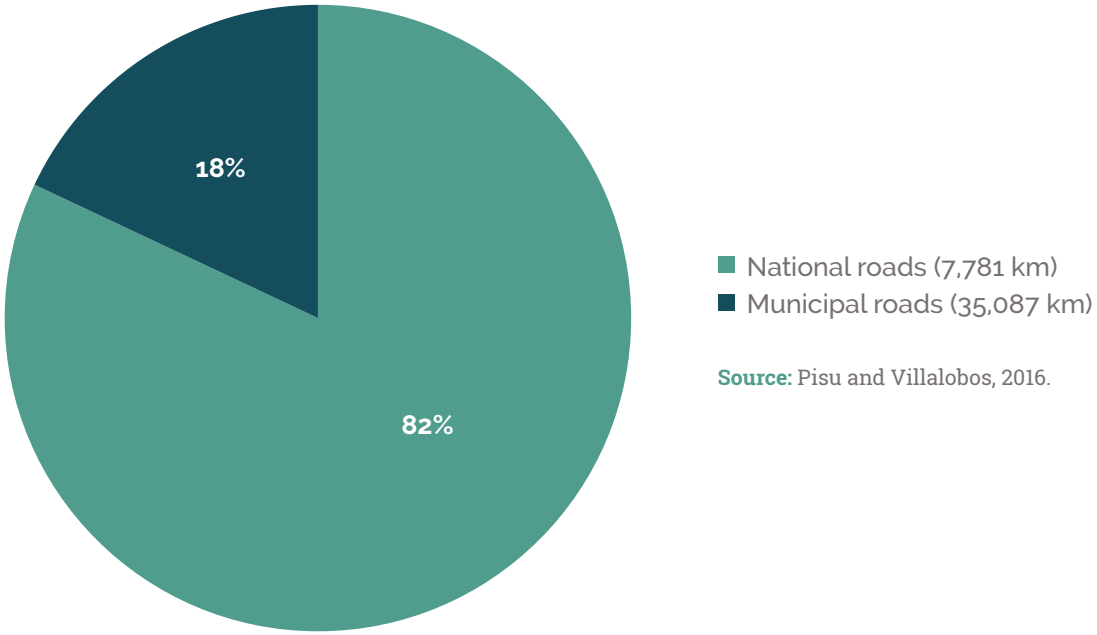
The Costa Rican transport sector is predominantly publically owned and operated. The three state-owned companies - National Railways Institute (*Instituto Costarricense de Ferrocarriles*, INCOFER), the Costa Rican Institute for Pacific Ports (*Instituto Costarricense de Puertos del Pacífico*, INCOP) and the Port Management Board of

the Atlantic Coast Development (*Junta de Administración Portuaria y de Desarrollo Económico de la Vertiente Atlántica de Costa Rica*, JAPDEVA) - are the dominant operators of maritime and train transport infrastructure. The responsibilities for the provision and management of the Costa Rican road network are shared between the public National Roads Council (*Consejo Nacional de Vialidad*, CONAVI) and municipal governments (Figure 2.4).

Water and sewage systems are publicly owned in Costa Rica. The Costa Rican Water and Sanitation Institute (*Instituto Costarricense de Acueductos y Alcantarillados*, AyA) together with the sub-national Public Services Company of Heredia (*Empresa de Servicios Públicos de Heredia*, ESPH) operate urban water and sewage systems throughout Costa Rica. In rural areas over 1500 Administrative Associations of Rural Water and Sanitation Systems (*Asociaciones administradoras de los Sistemas de Acueductos y Alcantarillados comunales en Costa Rica*, ASADAS) and Administrative Committees of Rural Water Systems (*Comités Administradores de Acueductos Rurales*, CAARs) operate water supply and sewage systems (Bower, 2013). The National Service for Ground Water, Irrigation and Drainage (*Servicio Nacional de Aguas Subterra´neas Riego y Avenamiento*, SENARA) operates water drainage and irrigation systems in Costa Rica (Bower, 2013).

In the Costa Rican education system, the majority of the country's more than 4000 schools are public, with at least one public elementary and high school located in every community. Only few private schools exist. In addition, there are six public universities in Costa Rica and several private universities. The Ministry of Public Education (*Ministerio de Educación Pública*, MEP) oversees public schools and ensures that educational facilities are designed to withstand hazardous events (UNISDR, 2008; OECD, 2017).

Figure 2.4. Costa Rica´s road network – ownership by jurisdiction



Source: Pisu and Villalobos, 2016.

Table 2.1. Operators of critical infrastructure in Costa Rica

Sectors	Operator	Ownership
Electricity & telecommunications	ICE Group (Grupo ICE)	National public
Electricity & telecommunications	Costa Rican Institute for Electricity (Instituto Costarricense de Electricidad, ICE)	National public
Telecommunications	Radiográfica Costarricense, RACSA	National public
Electricity	National Power and Light Company (Compañía Nacional de Fuerza y Luz, CNFL)	National public
Electricity & telecommunications; urban water systems	Public Services Company of Heredia (Empresa de Servicios Públicos de Heredia, ESPH)	Subnational public
Electricity & telecommunications	Administrative Board of the Municipal Electric Service of Cartago (Junta Administrativa del Servicio Eléctrico Municipal de Cartago, JASEC)	Subnational public
Electricity generation	Multiple small private companies (e.g. CoopeAlfaro Ruiz; Coopelesca R.L; COOPESANTOS)	Private
Petroleum refinery and distribution	Costa Rican Petroleum Refinery (Refinadora Costarricense de Petróleo, RECOPE)	National public
Telecommunications, internet	More than thirty private companies	Private
Health facilities	Costa Rican Department of Social Security (Caja Costarricense de Seguro Social, CCSS)	National public
Water and sewage systems	Costa Rican Water and Sanitation Institute (Instituto Costarricense de Acueductos y Alcantarillados, AyA)	National public
Water irrigation systems	National Service for Ground Water, Irrigation and Drainage (Servicio Nacional de Aguas Subterra´neas Riego y Avenamiento, SENARA)	National public
Water and sewage systems	Administrative Associations of Rural Water and Sanitation Systems (Asociaciones administradoras de los Sistemas de Acueductos y Alcantarillados comunales, ASADAS)	Subnational public
Water and sewage systems	Administrative Committees of Rural Water Systems (Comités Administradores de Acueductos Rurales, CAARs)	Subnational public
Ca. 20% of the road network	National Road Council (Consejo Nacional de Vialidad, CONAVI)	National public
Ca. 80% of the road network	Municipalities	Subnational public
Railways & train transport	National Railways Institute (Instituto Costarricense de Ferrocarriles, INCOFER)	National public
Pacific seaports	Costa Rican Institute for Pacific Ports (Instituto Costarricense de Puertos del Pacifico, INCOP)	National public
Caribbean seaports	Port Management Board of the Atlantic Coast Development (Junta de Administración Portuaria y de Desarrollo Económico de la Vertiente Atlántica de Costa Rica, JAPDEVA)	National public
Education sector	Ministry of Public Education (Ministerio de Educación Pública, MEP)	National public

Source: Bower, 2013; OECD, 2016a; SUTEL, 2016; Pisu and Villalobos, 2016; Response to the 2017 OECD Survey on the Governance of Critical Infrastructure.

Conclusion

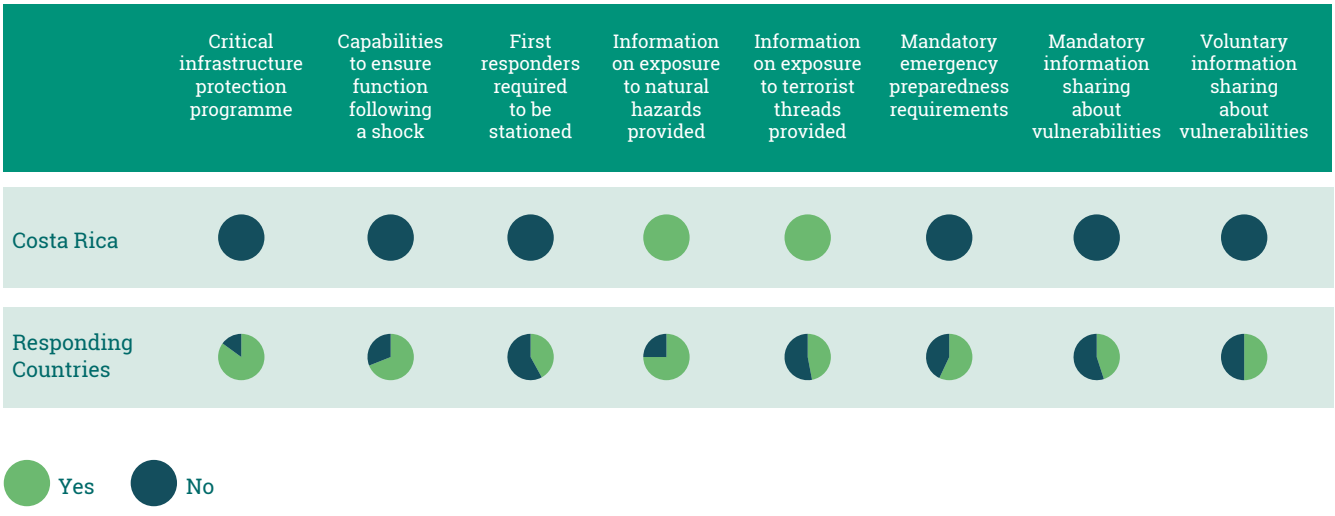
This section showed that the majority of critical infrastructure in Costa Rica is publically owned. Private companies are only slowly starting to play a role as operators of critical infrastructure in Costa Rica, e.g. in the telecommunications sector and to a certain extent also in the energy sector. An overview of the main actors operating critical infrastructure is an important basis enabling the government to design critical infrastructure resilience policies that take sectoral specificities into account.

2.4.2. Policy framework governing critical infrastructure resilience

A robust legal framework is an important tool to enable joint and coordinated action to strengthen the resilience of critical infrastructure. Regulations and policies can be used to encourage operators to integrate resilience in the design phase and in investments into new infrastructure, as well as into the management and use of standing infrastructure. A sound legal basis enables a systems approach to critical infrastructure resilience and provides the basis for coordination, information exchange and collaborative action among operators and the government. Ideally, a comprehensive national strategy for critical infrastructure provides the common framework, building on a criticality and interdependence assessment of critical infrastructure and assigning clear responsibilities (Fisher and Gamper, 2017). Results from the recent survey among countries that adhered to the OECD Recommendation on the Governance of Critical Risks show that twenty-nine countries have such a critical infrastructure resilience strategy or programme (CIP) in place, while only five —including Costa Rica— do not (Figure 2.6).

Although no specific national critical infrastructure resilience strategy or plan has been adopted in Costa Rica, information on requirements for critical infrastructure resilience is included in several policy documents. The National Law 8488 on Emergencies and Risk Prevention provides the overall framework for disaster risk management, and stipulates that operators need to have own

Figure 2.5. Snapshot: critical infrastructure resilience in Costa Rica



Note: Data from the OECD Survey on the Governance of Critical Risks is only available for 32 OECD countries plus Colombia and Costa Rica.
Source: OECD Survey on the Governance of Critical Risks.

emergency management plans in place. Actual components to be included in the emergency plans are not explained in further detail.

The General Internal Control Law requires infrastructure providers and enterprises to create institutional risk assessment systems (SEVRI). The SEVRI results should provide the basis for the design of business continuity plans that ensure service continuity, considering appropriate measures for quick return to pre-disaster conditions.

The National Policy for Risk Management (*Política Nacional de Gestión del Riesgo*) 2016-2030 and the mandatory National Risk Management Plan (*Plan Nacional de Gestión del Riesgo*) 2016-2020 stress that public infrastructure operators need to make risk-informed decisions and should take the necessary steps to reduce the risks they face, including through the purchase of hazard insurance.

The National Development Plan (*Plan Nacional de Desarrollo*) and the National Investment Plan (*Plan Nacional de Inversiones*) also stress that adaptive and disaster risk management capacities should be continuously strengthened, and that all new infrastructure projects should meet resilience objectives.

For the future, Costa Rica also intends to develop a National Cyber Security Strategy following the example of the Inter-American Cyber Security Strategy, and a plan for climate-proofing investments in the road and transport sector (Zaballos and Jeun, 2016).

Conclusion

This section showed that the body of policies concerning critical infrastructure in Costa Rica emphasises the need for building resilience, stressing the key role for operators. The policies address some important aspects of critical infrastructure resilience, such as the need for operators to assess their risks, and carry out apt disaster risk prevention and mitigation measures.

However, the available guidance and the obligations placed on operators, regulators and policy makers lack the level of detail and depth that comes with a national critical infrastructure resilience policy. For instance, while there is a requirement for public buildings to set up emergency management plans, guidance on the actual content and quality of these plans is limited. In addition, a central criticality and interdependence assessment —in many OECD countries an integral element of critical infrastructure resilience strategies— is not stipulated. Similarly, information-sharing mechanisms and partnerships between operators and the government are not included in the existing provisions.

2.4.3. Responsibilities for critical infrastructure resilience

In Costa Rica, the responsibilities for disaster risk management build on the principle of solidarity, but ultimately operators themselves are responsible for carrying out adequate resilience measures to prevent business disruptions. Although several line ministries and supervisory authorities have regulatory oversight roles, the Costa Rican legal framework foresees no clear responsibilities for enforcing the stipulated resilience objectives. The Comptroller General of the Republic (*Contraloría General de la República*, CGR) has a certain role to play in this regard, as it is charged with monitoring compliance with the requirement to implement the specific institutional risk analysis systems (SEVRIS). There are good signs that the Comptroller General is increasingly embracing this role, illustrated for instance by a recent special audit report on the status of prevention in the national road sector to evaluate the implementation of the National Risk Management Plan (CGR, 2017). The Fire Fighters are responsible for checking the availability of emergency management plans, but no organization is charged with checking the content of emergency plans, or whether business continuity plans have been adopted. The CNE oversees the effective implementation of National Law 8488 on Emergencies and Risk Prevention, but has not been given a specific mandate or responsibility to enforce critical infrastructure resilience.

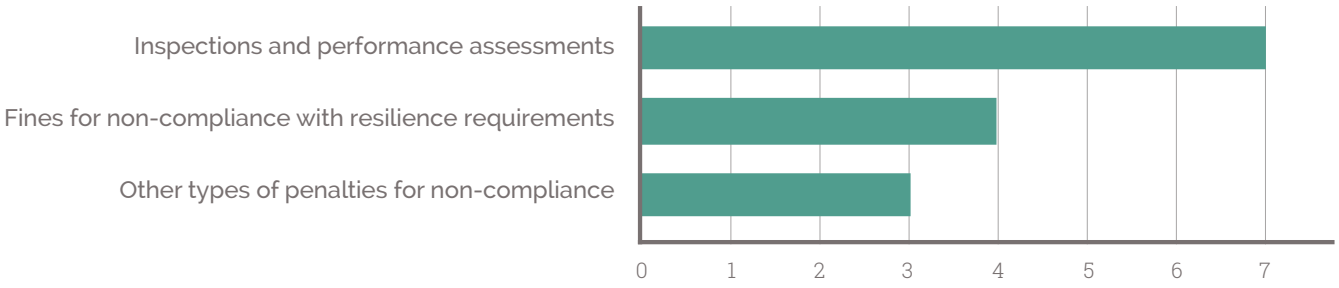
While owners and operators have an inherent interest to protect their assets and ensure business continuity, resources are limited and decisions to invest in resilience and protection are weighed against other investment needs with more imminent returns. Without a central level institution clearly mandated to promote critical infrastructure resilience, policy implementation may fall short of expectations. In many OECD countries, the respective civil protection agency or ministry of interior - often the institution also charged with the governance of critical risks - has the role of safeguarding critical infrastructure resilience. In some countries, such as Spain[2] and the United Kingdom[3], specific centres for critical infrastructure protection perform this role. In some OECD countries, such as Estonia, France, Latvia, Norway and Sweden regular inspections and performance assessments are carried out to check that resilience objectives have been met. In cases of non-compliance, operators can be penalised, e.g. by fining.

Nonetheless, good practices of stakeholders translating resilience objectives outlined in these policies into action exist in Costa Rica. The ICE Group and the CCSS, for instance, have embraced resilience measures that embody the principles of the OECD Recommendation on the Governance of Critical Risks. Areas of good practice range from ex ante risk financing mechanisms (also see section 2.1.6 on financing critical infrastructure resilience) to enterprise-wide resilience initiatives with a high level of buy-in from senior stakeholders (Box 2.3). Some operators have only recently started to develop resilience measures for their infrastructure. The Pacific ports operator INCOP, for instance, is currently developing a business continuity strategy that will be implemented once approved by its executive board. Risk managers from various sectors, including from the ICE, CCSS and CONAVI, participate in trainings and international workshops. In some critical infrastructure sectors, full translation of the stipulated resilience requirements is still a challenge. While overall operators reported uptake of non-structural measures as high, or at least planned for future action, investments in structural measures are less prevalent. In part, this is linked to chronic

[2] National Center for Infrastructure Protection and Cybersecurity (Centro Nacional de Protección de Infraestructuras Críticas, CNPIC)

[3] Centre for the Protection of National Infrastructure (CPNI)

Figure 2.6. Enforcing compliance with resilience requirements for critical infrastructure



Note 1: Answers received: 13 out of 14 responding OECD countries.
Note 2: Other types of penalties for non-compliance can include: revoking an operational license or temporary removal from service until requirements are met.
Source: OECD Survey on Critical Infrastructure.

budget shortages, which also contributes to poor levels of maintenance reported in some sectors, such as the road, water and sewage sectors. The recent hurricanes Otto and Nate have aggravated this situation, as basic service resumption eats up financial resources needed for maintenance and retrofitting measures.

Conclusion

In Costa Rica, the notion of solidarity is the key element driving the implementation of resilience measures at operator level. At central government level no single institution is charged with the general oversight of the implementation of policies for critical infrastructure resilience. The Comptroller General of the Republic has a certain role to play in this regard, while the CNE has not been given a specific mandate or responsibility to enforce critical infrastructure resilience. This differs from the practice in most OECD countries, where a designated lead institution oversees critical infrastructure resilience, often equipped with a toolbox of enforcement measures.

Operators have an inherent interest to ensure continuity of their operations, but resources are finite and investments in resilience compete with other investment needs that might bring more imminent returns. Without a central level institution clearly mandated to enforce critical infrastructure resilience, efficiency considerations may gain the upper hand, risking underinvestment in resilience.

In Costa Rica, some operators have started to implement comprehensive resilience measures, but most pointed to room for further action. While overall many operators carry out or at least plan non-structural measures, such as trainings for resilience officers, emergency plans and sometimes also business continuity plans, investments in structural measures, including retrofitting of critical infrastructure at risk, are less prevalent. Some operators have also set up own contingency funds, in addition to taking up comprehensive insurance packages, to prepare for the costs of disaster recovery. Others, on the other hand, have not taken such ex ante measures, depending almost exclusively on public assistance for disaster recovery.

Box 2.3. Spotlight on good practices: the Costa Rican Department of Social Security and the Costa Rican Institute for Electricity Group

The **Costa Rican Department of Social Security** (Caja Costarricense de Seguro Social, CCSS) and the **Costa Rican Institute for Electricity Group** (Grupo Instituto Costarricense de Electricidad, ICE Group) both implemented notable programme of works aimed at enhancing the resilience of the infrastructure under their responsibility. In both cases, resilience officers continuously aim to reinforce these programmes, participating also in international trainings and exchange.

In recognition of the need to ensure the resilience of hospitals and health facilities under its management, the **CCSS** in 2006 created the "Safe Hospital" programme (Política Institucional de Hospital Seguro). The programme outlines provisions for increasing the resilience of its infrastructure, including redundancies in case of supply chain disruptions. As part of the programme, the CCSS calculated the cost of retrofitting and, where needed relocating, exposed hospitals. Using the Hospital Safety Index of the Pan American Health Organisation[4], hospitals under CCSS management were prioritized for resilience measures, with the majority of these measures concluded since the programme's launch. The prioritization also considered the potential socio-economic effects of a loss of the facility.

In addition, the CCSS conducts interdependence assessments to develop measures that enable the effective functioning of its hospitals, even when critical services such as water or electricity are disrupted. The assessment results are used in support of business continuity plans and to develop redundancies and back-up capacities, e.g. stand-alone back-up power systems and on-site water tanks. The CCSS has also implemented a comprehensive resilience financing strategy that includes funding earmarked for resilience measures, hazard insurance and a contingency fund to finance disaster recovery efforts that exceed insurance pay-outs.

Similarly, the electricity and telecommunications services provider **ICE Group** has paid noteworthy attention to the resilience of its infrastructure. With the Coordination Center for Emergency Operations, the ICE Group created a unit specifically tasked with ensuring the resilience of its activities, including the disturbance elimination and recovery of damaged assets. In addition, the Coordination Centre may step-in to contribute to broader disaster recovery efforts, as overseen by the National Emergency Commission. Following major disruptions in energy or telecommunications provision, the Coordination Centre organizes lessons-learnt workshops, in which good practices as well as challenges are discussed. The objective of these workshops is to enable continuous resilience improvements.

Reflecting the high level of buy-in from senior stakeholders, a senior corporate committee defines the criticality of ICE infrastructure, and prioritizes assets to concentrate resilience efforts. Georeferenced asset maps that consider interdependencies within Costa Rica are under development. Interdependences between the electricity systems across the integrated electricity systems of the Central American Electrical Interconnection System (SIEPAC) are known, with redundancies in place. This contributed to the fast recovery of electricity provision following the Central American blackout in July 2017, which in Costa Rica was substantially shorter than in other countries along the shared transmission line. The ICE Group also implemented a comprehensive hazard insurance strategy. The experience of past disasters has illustrated the benefits of purchasing hazard insurance, with pay-outs contributing to the speedy recovery of damaged assets and thus preventing long-term energy supply disruptions.

Source: 2018 OECD fact-finding mission to Costa Rica.

[4] http://www.paho.org/disasters/index.php?option=com_content&view=article&id=960:what-is-the-hospital-safety-index&Itemid=1252&lang=en

2.4.4. Cooperation arrangements for the governance of critical infrastructure resilience

Robust information-sharing mechanisms between the government and operators create trust and enable the design of critical infrastructure resilience policies that account for actual resilience gaps and societal needs. Resilience-focused information-sharing mechanisms and cooperation platforms are valuable tools to help operators prioritize resilience objectives in line with societal needs and coordinate actions, even in cases where competition may otherwise hamper dialogue. At the same time, cooperation arrangements and partnerships can create peer pressure useful for upscaling resilience across all critical sectors. Ideally, such platforms also enable the design of mutual assistance arrangements, and provide for the exchange of good practices and lessons learned in the aftermath of disruptions (Fisher and Gamper, 2017; OECD, *forthcoming b*).

Increasingly, efforts are made to engage operators in cross-sectoral dialogue and planning for extreme events are in place in Costa Rica. Some, but not all public critical infrastructure operators are represented in the Emergency Operations Centre (*Centro de Operaciones de Emergencia*, COE), contributing to disaster response and recovery measures. Following disaster recovery, the CNE organizes lessons-learnt workshops, in which all stakeholders, including operators, engaged in the disaster recovery efforts come together to discuss success factors. Bottlenecks and challenges to be overcome for more effective recovery, or gaps in preventive measures, are usually not addressed in these workshops. Once per year, the National Risk Forum (*Foro Nacional sobre Riesgo*) brings together all stakeholders of the national risk management system, including representatives from the sectors designated as critical infrastructure. In addition, the newly created Public-Private Partnership (PPP) Committee for Business Continuity and Risk Management (*Comité Sectorial de Alianza Público Privada para la continuidad del negocio y la gestión del riesgo*), which includes critical infrastructure operators as well as private sector representatives, fosters exchange.

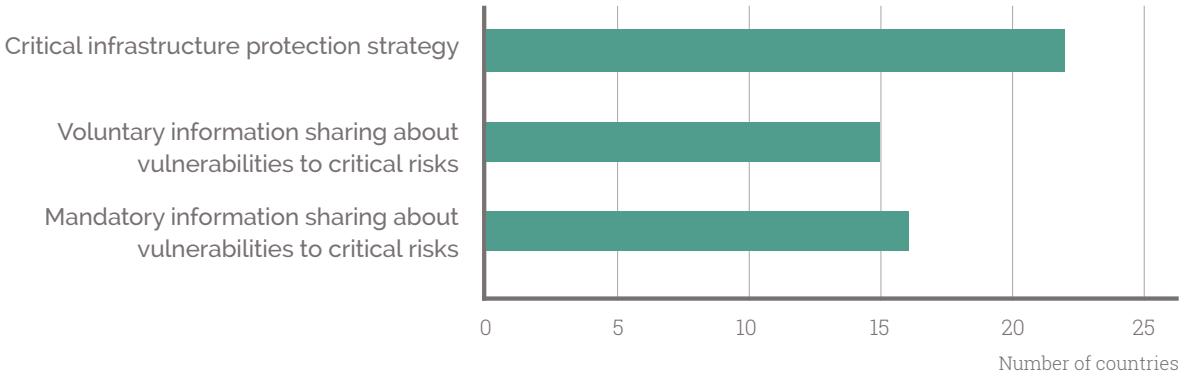
Costa Rica's available cross-sectoral platforms and planning mechanisms are very useful features of the National Risk Management System (*Sistema Nacional de Gestión de Riesgo*), but they take a much wider focus than critical infrastructure resilience. Their wider scope makes it harder for them to be used as safe information-sharing mechanisms between operators and the government, in which even sensitive topics can be discussed. In many countries where such cross-sectoral critical infrastructure platforms exist, specific safeguards are in place to protect confidential information.

In addition to the broader cross-sectoral platforms, some sectoral disaster risk management committees (*Comités sectoriales de gestión del riesgo*) are in place. These sectoral committees bring representatives from the various parts of each sector, for example the transport sector committee brings representatives from ports, airports and other transport modes together to better coordinate actions amongst each other. In the education sector committee representatives from various education authorities, including the Ministry of Education and the National Institute of Learning (*Instituto Nacional de Aprendizaje*) together with the CNE coordinate the development of coherent disaster risk management measures in the education sector. Despite the existing platforms, access to information relevant for implementing effective critical infrastructure resilience measures in Costa Rica is still a complex challenge. Information exchange between operators and government agencies, e.g. the CNE, and among operators of critical infrastructure, many of which are publically owned in Costa Rica, is not guaranteed. In some cases, information can only be obtained against the payment of fees, or following several reminders, while in other cases

the information quality has been cited as a concern (CFR, 2017). Sometimes, exchange is more direct, relying on informal communication channels and contacts established at the available broader cross-sectoral platforms, such as the annual National Risk Forum. Following disaster, some operators, such as the ICE Group, also participate in recovery efforts that go beyond restoration of their own affected assets.

In many OECD countries critical infrastructure protection strategies have proved useful for engaging operators and the government in regular dialogue and information-sharing. Results from a recent survey on the Governance of Critical Risks, carried out in the process of reporting progress in the implementation of the OECD Council Recommendation on the Governance of Critical Risks (OECD, 2014b) showed that in twenty-two countries a national critical infrastructure resilience strategy provides the basis for the scheduling of regular meetings between the responsible authorities and operators to ensure adequate and regular exchange of relevant information (Figure 2.7). In some countries, where the sharing of information relevant for the resilience of critical infrastructure is not mandatory, voluntary information-sharing takes place. In such cases, an overarching national critical infrastructure resilience strategy can be a useful point of reference to foster regular exchange and stakeholder engagement (Box 2.3). Mutual aid agreements complement the exchange of information about vulnerabilities in some countries. In the United States and Canada, for instance, electricity providers are required to have mutual assistance plans in place. In the United Kingdom the water sector has an industry-wide mutual aid agreement to enable sharing of resources in case of infrastructure disruptions, so as to deliver upon the obligation to provide sufficient drinking water to households (Asgary et al., 2017; Cabinet Office, 2016).

Figure 2.7. Partnerships with critical infrastructure operators



Note: Answers received: 29 out of 34 responding Adherents.
Source: OECD Survey on the Governance of Critical Risks.

Conclusion

This section illustrated that some efforts to engage operators and the government in cross-sectoral dialogue are in place in Costa Rica. Operators and the government meet at the annual National Risk Forum, and increasingly also at the PPP Committee for Business Continuity and Risk Management. To ensure effective disaster response and recovery, operators are also represented in the COE.

These platforms are valuable elements of Costa Rica's National Risk Management System, but their focus differs from that of information-sharing mechanisms created specifically for the safe exchange of information between operators and the government. The wider audience of the National Risk Forum and the PPP Committee for Business Continuity and Risk Management make them less suitable for safe information-sharing between operators and the government, in which even sensitive topics can be discussed. The COE, on the other hand, has a smaller audience, but focuses on coordinating emergency response and recovery. The sectoral committees are a good starting point for exchange among operators and the government, but remain limited to exchange within the respective infrastructure sector. Similarly, the assistance some operators provide following disaster, could serve as a starting point for the adoption of Mutual aid agreements complementary to information-sharing arrangements.

Box 2.4. National Strategy and Action Plan for Critical Infrastructure as a tool to foster partnerships in Canada

The National Strategy for Critical Infrastructure sets the direction for enhancing the resilience of Canada's critical infrastructure against all current and emerging hazards. It provides the framework for a collaborative approach and outlines mechanisms for enhanced information-sharing and information protection among the key factors necessary to support and enhance the resilience of critical infrastructure in Canada. The supporting Action Plan for Critical Infrastructure (2014-2017) set out action items for the strategic objectives of the National Strategy.

To carry out the objective to build partnerships the Strategy provides for the creation of ten central level sector networks for each of the critical infrastructure sectors, integrating existing coordination and consultation mechanisms. As a result, relevant central and subnational government authorities, national associations and critical infrastructure sectors set up ten sector networks (Table 1). The networks serve as fora to jointly identify hazards and threats and to use subject-matter expertise to address these. In addition, the networks facilitate sharing good practices for strengthening the resilience of critical infrastructure. To safeguard information shared through these networks, stakeholders put network-specific protocols in place.

CANADIAN CRITICAL INFRASTRUCTURE SECTOR NETWORKS

National Cross-Sector Forum Membership:
operators, government (central and subnational)

Energy & Utilities	Information & Communication Technology
Finance	Health
Food	Water
Transportation	Safety
Government	Manufacturing

Source: Public Safety Canada (2015)

An overarching National Cross-Sector Forum that groups representatives from the ten sector networks is in place. Meeting once per year, the Forum promotes information sharing and business resilience collaboration across the sector networks. It also is the principal place to address cross-jurisdictional and cross-sectoral interdependencies.

Source: Public Safety Canada, 2015a; Public Safety Canada, 2015b.

2.5. Financing the resilience of critical infrastructure

Making critical infrastructure resilient comes at a cost. To ensure that resilience is prioritized and that operators carry out the necessary measures, suitable financing arrangements are needed. When much of the critical infrastructure is publically owned, governments do particularly well to ensure the resilience of new investments in public infrastructure, and to develop financing solutions for retrofitting standing infrastructure to prevent high public spending for infrastructure recovery in the aftermath of disaster. At the same time, encouraging operators to take on the extra costs of investing in increased levels of resilience can be challenging, as it requires trade-offs and may not bring immediate returns (Fisher and Gamper, 2017).

In Costa Rica, various policy documents point to the need to earmark sufficient funding for the resilience of critical infrastructure. The National Investment Plan, the National Development Plan 2015-2018, as well as the National Policy for Risk Management all require that new public investments meet resilience objectives and that existing resilience gaps in standing public infrastructure are closed. In addition, Law 8488 stipulates that resources need to be allocated to disaster risk management measures based on the results of disaster risk assessments (MIDEPLAN, 2014; MIDEPLAN, 2016).

At the end of the day, however, each operator is responsible for financing its own ex ante disaster risk management measures. Some operators, such as the General Directorate of Civil Aviation (*Dirección General de Aeronáutica* Civil, DGAC), the CCSS and the ICE Group, for instance, have specific funding set aside for conducting hazard assessments and carrying out resilience measures. Others, including CONAVI and the Ministry of Public Works and Transport (*Ministerio de Obras Públicas y Transportes*, MOPT), do not yet fully comply with the requirement to earmark resources for prevention and mitigation purposes (CGR, 2017). Overall, many stakeholders reported that even where there is high awareness of the value of resilient infrastructure, making the case for actually channelling funds to resilience measures can be challenging. To encourage retrofitting of schools, hospitals, bridges, and levees – some of which fall in the category, where channelling funds to resilience measures has proved particularly complex - the CNE may provide funding, but the budget set aside for this is small (World Bank, 2012; OECD, *forthcoming c*).

To finance the cost of disaster recovery in Costa Rica, the government has promoted the availability of ex ante risk transfer tools to enable financial resilience at operator level. Most operators that have insurance purchase their cover from the public insurance company, the National Insurance Institute (*Instituto Nacional de Seguros*, INS). In addition, private insurers offer insurance that some operators use in place of cover offered by INS.

In practice, hazard insurance penetration for critical infrastructure is not at the intended levels, and where insurance is available, it only covers a part of the damages. For some high risk critical infrastructure, such as roads and bridges as well as water networks, insurance is not available altogether. In addition, some operators reported that insurance is only available for office buildings, while for more critical assets insurance options are missing or are not affordable. In part, this is linked to the premium setting mechanism applied by the largest insurer, the INS, which would result in substantially higher overall premiums, if high risk infrastructure were insurable. At the same time, budgetary constraints amongst operators have meant that in some cases insurance cover is bought for the bare minimum, on occasions leaving critical assets out of scope of policies or limiting policies to only a handful of hazards.

To encourage the uptake of insurance for public infrastructure, the Government of Costa

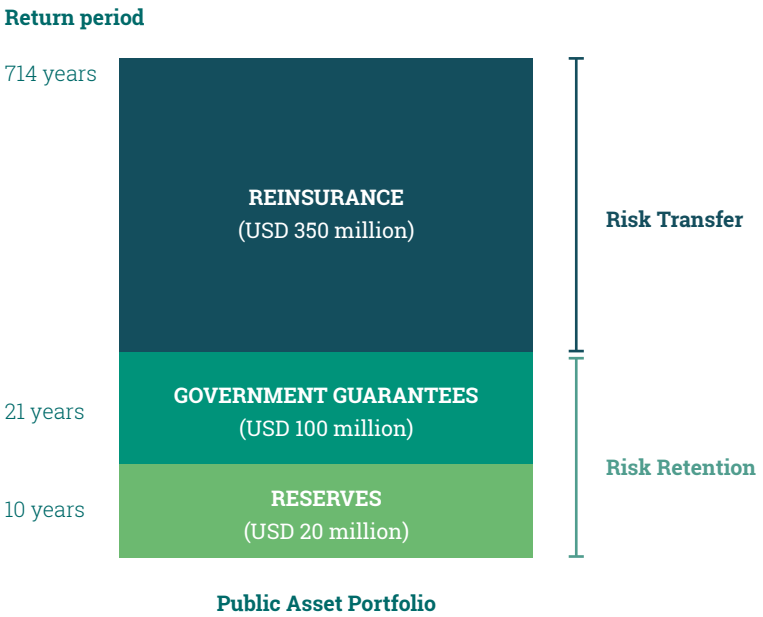
Rica via the INS offers a catastrophe risk transfer vehicle (CRTV). The CRTV provides insurance for public assets at a lower cost than what would otherwise be available, backed by government guarantees and competitive reinsurance rates (Figure 2.8)(Mahul et al., 2013).

Beyond promoting insurance, the government has established the National Emergency Fund (*Fondo Nacional de Emergencia*, FNE), composed of mandatory transfers from public entities set at 3% of budget surplus, and donations from various sources. Managed by the CNE, the fund is the main source of risk financing in Costa Rica. Public institutions, including public operators of critical infrastructure and sub-national levels of government managing local infrastructure, have access to the Fund. Funding can only be made available when an official emergency declaration has been issued, but it is not conditional on the implementation of ex ante resilience measures.

The significant variations in the Fund's budget (Figure 2.9), and the fact that disaster recovery support from it can only be requested when an official emergency declaration has been issued, limit the Fund's potential for application. As many of the damages incurred by operators are the result of smaller hazardous events, such as heavy swell along the coast or heavy rainfall, that do not qualify for an official emergency declaration, much of the disaster recovery costs has to be borne by operators themselves. In addition, the high finance needs associated with the recovery of infrastructure in poor state of maintenance even before a disaster occurred, have eaten up much of the Fund's reserves.

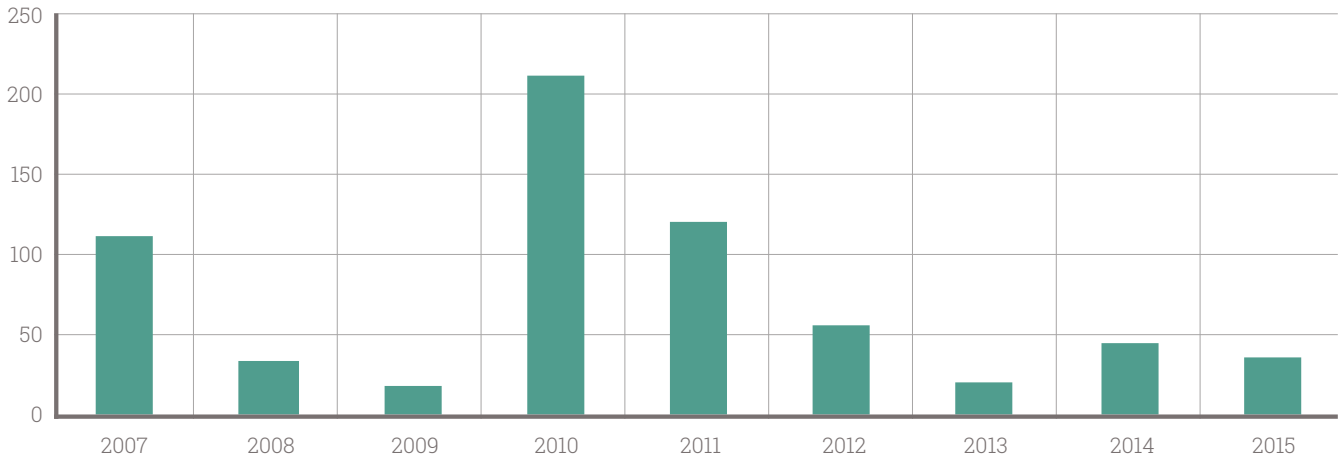
Some operators have taken exemplary measures to ensure their financial resilience against disaster risks, coupling comprehensive hazard insurance with their own contingency funds. The CCSS, for instance, created its own contingency fund to

Figure 2.8. Costa Rican catastrophe risk transfer vehicle for public assets, as offered by the National Insurance Institute



Source: Mahul and Ghesquiere (2010).

Figure 2.9. Annual budget of the National Emergency Fund from 2007 to 2015



Note: * USD exchange rate of the Central Bank of Costa Rica 20/04/2016.
Source: Data from the Administrative-Financial Management Direction, CNE, 2016.

complement insurance pay-outs. The fund channels 1.83% of the CCSS' annual budget for disaster recovery purposes. In 2016, its inception year, the fund held USD 26 million, to be scoped up to USD 78 million over the next two years. The fund can exclusively be used to recover damages to health facilities, and has to be used to build back without reproducing risks.

Conclusion

This section showed that Costa Rica has taken important steps to support critical infrastructure operators in financing disaster recovery costs, but could do more to incentivise the implementation of ex ante resilience measures. Available support focuses on disaster recovery and is not tied to the implementation of ex ante resilience measures. In some cases, the CNE may be able to provide funding in support of ex ante measures, but the budget for this is tight. Insurance products are widely available, and even required for public assets, but in practice budgetary constraints have often meant that insurance cover is bought only for the bare minimum, if at all. For high risk critical infrastructure insurance is not available altogether.

The FNE has proved useful in supporting recovery efforts across Costa Rica, but some challenges persist. In the past, much of the available funding has gone towards the recovery of infrastructure that was poorly maintained before the disaster, or covered by little or no insurance. As eligibility for FNE funding is not tied to implementing ex ante resilience measures, incentives to invest in resilience measures have become skewed. Various other factors add to this: (i) repeat eligibility for funding from the FNE independent of betterment measures; (ii) limited financial support for ex ante resilience measures coupled with budgetary constraints at operator level; (iii) an absence of inspections and penalties for non-compliance with resilience objectives. At the same time, the FNE's resources are limited, and there have been instances where the available funding did not meet the needs of affected operators, and other public institutions.

Conclusion

Critical infrastructure resilience is an essential for Costa Rica's national resilience and continued sustainable development. National resilience entails the ability to prepare and plan for, absorb, recover from, and more successfully adapt to major adverse events and disasters. Costa Rica's high exposure to a wide range of natural hazards threatens critical infrastructure across the country. Disruptions in critical infrastructure can have cascading impacts that resonate far beyond the affected area, impeding disaster recovery efforts, at worst hampering long-term sustainable development and driving inequalities.

Assessment

Costa Rica has made substantial investments in emergency preparedness and disaster management capacities at critical infrastructure level.

At the national level, various policies stress the value of critical infrastructure resilience, contributing to the uptake of resilience measures at operator level. Many operators have started to implement comprehensive resilience measures, and some showcase exemplary resilience efforts. When operators experience disaster-related damages, the National Emergency Fund may be tapped upon, and hazard insurance is available.

At the same time, a number of challenges and governance gaps persist in Costa Rica, calling for further strengthening of critical infrastructure resilience efforts.

The existing policies are not sufficiently detailed and do not build on a common national criticality and interdependence assessment that could help operators prioritize investments into resilience. Access to the National Emergency Fund is not tied to ex ante resilience measures taken, nor to whether an asset has been damaged for the first, or for the umpteen time, skewing incentives for investing in resilience. Accountability frameworks leave room for reinforcement, and cross-sectoral cooperation and information-sharing is not developed and far-reaching enough to create peer pressure and a common sense of responsibility that ensures optimal investments in resilience. As a result, substantial resilience disparities exist between sectors, with some sectors' resilience lagging far behind.

In light of the interdependencies among critical infrastructure, the system as a whole ends up being as fragile or strong as its weakest link. By improving the governance arrangements for critical infrastructure resilience, Costa Rica can unlock high returns for its resilience in the future. In particular, the case study makes the following recommendations for improving the governance of critical infrastructure resilience in Costa Rica.

Recommendations

1. Launch a standardized national criticality and interdependence assessment for critical infrastructure.

Costa Rican authorities should establish a national criticality and interdependence assessment to

identify critical systemic nodes and prioritise resilience measures accordingly. At present, criticality and interdependence assessments in Costa Rica are only conducted at operator level, if at all. The absence of a national assessment jeopardizes a common understanding of what assets and systems are truly critical, and thus hampers a prioritisation of resilience measures that take vulnerabilities in critical nodes into account.

There are various approaches to go about criticality assessments, but for it to be successful at national level strong cooperation and trust between stakeholders is key. Operators are well-placed to assess the criticality of their own assets, and to identify their own interdependencies, but to ensure compatibility and coherence central guidance is necessary. A central government authority, such as the National Emergencies Commission (CNE), would be well-placed to take the lead in defining a common approach, coordinating it closely with operators. The CNE would then also be well-placed to bring the results together, and analyse them in light of systemic interdependencies, while ensuring confidentiality. Technical expertise and analyses from security-cleared resilience officers from operators and other pertinent stakeholders, including the Ministry of National Planning and Economic Policy, should complement the systemic analyses to realize a comprehensive and valid assessment.

In a subsequent step, the CNE could then take the lead to develop a common critical assets inventory, in which assets are classified according to their criticality. Maps that illustrate interdependencies would be a useful complement. Ideally, the registry and maps would be accessible by relevant representatives from operators and the government, protected by strong safeguards and security protocols. Access to this information enables operators and government alike to optimally prioritize resilience measures.

2. Adopt a national critical infrastructure resilience strategy offering as comprehensive policy guidance for all stakeholders.

To create the necessary legal basis for the successful implementation of the above recommendations, the Government of Costa Rica should adopt a comprehensive national critical infrastructure resilience strategy building on the standardized national criticality and interdependence assessment. To date, critical infrastructure resilience objectives in Costa Rica are spread across a body of policies that lacks sufficient detail and depth, and does not entail accountability mechanisms. In addition, the underlying definition of critical infrastructure takes a somewhat localized view that does not fully account for potential cascading effects of critical infrastructure disruptions.

A national critical infrastructure resilience strategy should provide strong legal guidance along the steps outlined in the policy framework developed by the OECD and the IDB, addressing the above recommendations to (i) create a standardized national criticality and interdependence assessment for critical infrastructure; (ii) ensure effective incentives for investing in ex ante resilience measures at operator-level; (iii) establish accountability frameworks for consistent implementation of resilience measures across all critical sectors; and to (iv) boost information-sharing and partnerships across stakeholders, building on the availability of disaster risk assessments.

Ideally, the national critical infrastructure resilience strategy follows broad stakeholder consultations with operators of critical infrastructure, concerned regulatory authorities and ministries and relevant actors under the National Risk Management System. To ensure extensive critical infrastructure resilience, the strategy should promote an all-hazards approach to disaster risk management and define clear objectives. Ideally, an action plan that sets out action items for the strategic objectives and timelines for their implementation complements the strategy.

3. Ensure effective incentives for investing in ex ante resilience measures at operator-level.

To convince operators to take on the extra costs of investing in increased levels of resilience, the government needs to ensure effective incentives. Currently, recovery funding in Costa Rica is available to operators independent of the resilience measures taken, and regardless of whether an asset has been damaged for the first, or for the umpteen time. This has resulted in some operators relying almost exclusively on public assistance for disaster recovery. As public funds available for recovery are very scarce, the high funding needs of those that did not invest in ex ante measures often took funding away from those that have, further skewing incentives.

There are various options to address these skewed incentives for ex ante measures. Firstly, the size of recovery payments via the National Emergency Fund (FNE) could be linked to the implementation of certain ex ante resilience measures, such as retrofitting or insuring at least a pre-defined percentage of most critical assets. In addition, requirements to use recovery funding to build back more resilient infrastructure could be introduced. Secondly, the government should define provisions to enforce compliance with resilience requirements for critical infrastructure, such as fines or corrective measures. Ideally, dialogue between operators and pertinent line ministries will have informed the design of the penalties catalogue.

4. Establish accountability frameworks for consistent implementation of resilience objectives across all critical sectors.

To ensure successful and consistent implementation of resilience objectives across critical infrastructure, the authorities should create robust accountability frameworks. At present, the responsibility for critical infrastructure resilience in Costa Rica is concentrated at operator level, with a very narrow role for the government to hold operators accountable. In default of accountability frameworks, some operators have significantly underinvested in resilience measures.

In order to hold critical infrastructure operators accountable, clear oversight responsibilities at central government level are important, with a shared role for the National Emergencies Commission and the Comptroller General of the Republic. To enable this, strong cooperation based on clear and binding agreements is key in this regard. Considering the Comptroller General's auditing role, it would be well-placed to conduct critical infrastructure resilience inspections as part of the regular audits, as previously done for the transport sector. In addition, the National Emergencies Commission's role should be strengthened to include oversight over critical infrastructure resilience in its mandate. This would also include a responsibility to keep track of non-compliance cases, checking them against the critical assets registry, and ensure follow up with apt corrective action. To deliver the benefits of the suggested shared critical infrastructure resilience oversight, sufficient funding, along with adequately qualified technical staff are important.

5. Boost information-sharing and partnerships across stakeholders, building on the availability of disaster risk assessments.

The government should establish robust information-sharing and partnership mechanisms with operators to enable the design of critical infrastructure resilience policies that account for actual resilience gaps, and to create a trust-based, collaborative environment. At present, only limited cross-sectoral exchange and coordination between operators and the government takes place in Costa Rica. In some cases information about hazards or weak points along supply chains is only available for a fee or after several reminders, if at all. As this information is hard to obtain, operators face difficulties in designing apt resilience measures that take vulnerable nodes into account.

Information-sharing and dialogue could be strengthened by creating a cross-sectoral critical infrastructure platform that meets several times per year to discuss and coordinate resilience matters and actions. Such a platform should bring together all relevant representatives from operators of critical infrastructure and the government, and ideally provide for exchange of relevant security information and subject-matter expertise, lessons learning following disruptions. At best, the platform would also enable the development mutual assistance agreements, including sharing of equipment and emergency stocks, and joint exercises. Agreements that also address data protection and competition questions should underpin the partnership between operators and the government. In light of its technical expertise, and experience in coordinating the National Risk Management System the National Emergencies Commission would be well placed to take the central government lead in setting up the national critical infrastructure platform.

6. Ensure financing arrangements to increase resilience of critical infrastructure.

To strengthen critical infrastructure resilience, the government needs to ensure suitable financing arrangements. With the National Emergency Fund Costa Rica has taken an important step in this direction, supporting operators in financing disaster recovery costs. In terms of ex ante resilience measures, financing arrangements are less advanced, with some limited support available from the National Emergencies Commission. In addition, the government has promoted the availability of ex ante risk transfer tools to boost financial resilience at operator level. In practice, however, hazard insurance penetration for critical infrastructure is not always at the intended levels.

To support operators in carrying out their resilience responsibilities, Costa Rica should consider creating a critical infrastructure resilience fund that would allow giving partial financial support for ex ante disaster risk management measures to operators. Potential sources for funding include industry levies or fines for non-compliance with resilience requirements. The results of the national criticality assessment should help prioritise resilience measures that should receive partial financial support from this fund. In addition, the government and the National Insurance Institute should further cooperate to improve the affordability of effective insurance cover, making uptake more attractive to operators. The catastrophe risk transfer vehicle (CRTV) is a good step in this direction.

Tables

Figures

Boxes

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