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Session 4: Taking Flight Towards Climate Resilience:
Building Adaptation Strategies for Airports



Enhancing Air Transport Resilience in The Caribbean

The World Bank, Latin America and the Caribbean Transport Unit

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CARIBBEAN REGIONAL RESILIENCE BUILDING FACILITY

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EUROPEAN UNION



GFDRR

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Caribbean airports have faced many challenges in recent years, demonstrating the criticality of resilience investments

- **Haiti:** In 2010, a major earthquake struck Haiti, resulting in the loss of more than 200,000 lives and severely damaging infrastructure across the Port-au-Prince region, including the Port and the international airport. In 2024, Port-au-Prince's main airport was closed for several weeks due to civil unrest and targeted actions against the airport.
- **Dominica:** In 2015, Tropical Storm Erika crippled Dominica's main airport with severe flooding. A full shutdown lasted for several weeks, with operational limitations extending for many subsequent months.
- **Sint Maarten:** In September 2017, Category 5 Hurricane Irma and Category 4 Hurricane Maria wreaked havoc across the Caribbean, inflicting over \$100 million in damage to Princess Juliana International Airport on the island of Sint Maarten. The storms severely damaged the airport's passenger terminal building, leaving it unusable due to wind damage, flooding, and extensive mold damage throughout the structure. The runway was also temporarily closed.
- **Puerto Rico:** Hurricane Maria (2017) also damaged and flooded several major airports in Puerto Rico
- **Bahamas:** In 2019, Hurricane Dorian dealt a harsh blow to Bahamas airports.
- **Saint Vincent and the Grenadines and nearby countries:** In 2021, a volcanic eruption in SVG caused significant disruptions to airport operations not only on the island of Saint Vincent, but also in nearby Barbados and Saint Lucia, due to the ash carried by wind currents.

St. Maarten – Post Irma / Maria 2017



The 'Enhancing Air Transport Resilience in the Caribbean' study was launched in 2021 as part of a larger World Bank initiative in the region

- EATRC includes the three countries participating in the Caribbean Regional Air Transport Connectivity Project (CATCOP):
 - Grenada: Maurice Bishop International Airport (MBIA)
 - Saint Lucia: Hewanorra International Airport (HIA)
 - Haiti: Toussaint Louverture International Airport (PAP) and Cap Haïtien International Airport (CAP)
- CATCOP is financed by the World Bank, currently involving Grenada, Haiti, and Saint Lucia. It aims to enhance regional connectivity by improving the safety and resilience of air transport.
- EATRC is financed by Caribbean Regional Resilience Building Facility. The study also aims to benefit the remainder of the Caribbean region, and Small Island Developing States (SIDS) in other parts of the world, by identifying relevant best practices and systems, with emphasis on airports.



Funding provided by the Caribbean Regional Resilience Building Facility

- The Caribbean Regional Resilience Building Facility, launched in 2019, was set up in the aftermath of the 2017 hurricanes Irma and Maria.
- It is partnership between the European Union (EU), the World Bank Group, and the Global Facility for Disaster Reduction and Recovery (GFDRR)
- The objective of the Facility is to enhance long term resilience and adaptation capacity in the Caribbean region to the benefit of the most vulnerable.

Beneficiary countries:

Antigua and Barbuda, Bahamas, Barbados, Belize, Dominica, Dominican Republic, **Grenada**, Guyana, **Haiti**, Jamaica, St. Kitts and Nevis, **St. Lucia**, St. Vincent and the Grenadines, Suriname, Trinidad and Tobago.



Enhancing airport resilience is always challenging

Large land areas increase threat exposure	To accommodate the infrastructure necessary to support international air service, especially airfield infrastructure given runway length requirements, creates greater exposure to threats
Many infrastructure elements and users to protect	Runways, taxiways, terminal facilities, aircraft hangars and maintenance facilities, aircraft fueling systems, cargo facilities, access/egress roadways, car parking, Crash Fire Rescue (CFR) services and equipment, energy supplies, water supplies, international waste disposal systems, IT systems, health systems, safety systems, security systems, sensitive air navigation equipment, and more
Elevated safety standards	Especially commercial service airports with international service
High costs	Costly to build, operate, and maintain airports that provide adequate capacity and meet international standards for safety and level of service, independent of any resilience considerations



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Airport resilience in the Caribbean region is particularly challenging

Natural disaster risk is already high; climate change heightens this

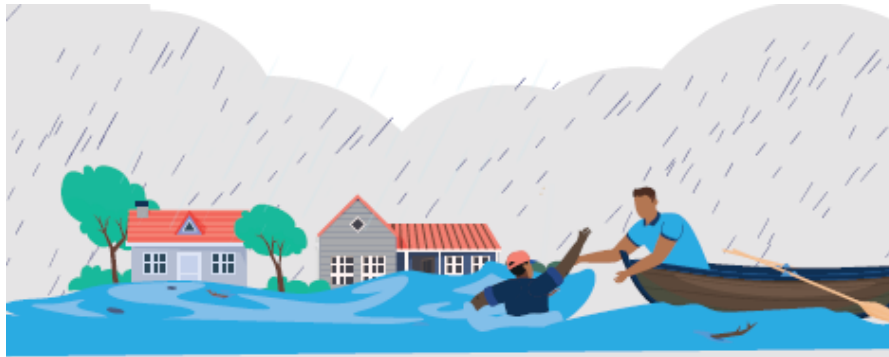
Financially challenged regional airline industry

Small island developing states with airports located near the sea

Under-funded and under-equipped airports

Inconsistent regulatory oversight and safety performance

Competitive dynamics among countries



A key theme in the Caribbean: Under-funded and under-equipped airports



Governments have limited economic means – small populations and limited tax base



Airports have relatively low traffic and revenue levels, yet they are capital-, O&M-, and human resource-intensive; aviation revenues are sometimes diverted for non-aviation uses



Underdeveloped non-aeronautical revenues limit financial performance and investment capacity



Capital investment needs often exceed funding availability

Nav aids, safety infrastructure, climate/disaster resilience infrastructure



High aeronautical charges are common, especially when non-aeronautical revenues are low, but they negatively impact airline costs and travel demand



Limited local supply of human resources and inadequate investment in skills development



Management incentives not well aligned with addressing structural challenges and pursuing opportunities

In summary, Caribbean airports face:



Limited financial and human capital



High costs to maintain airports at international standards



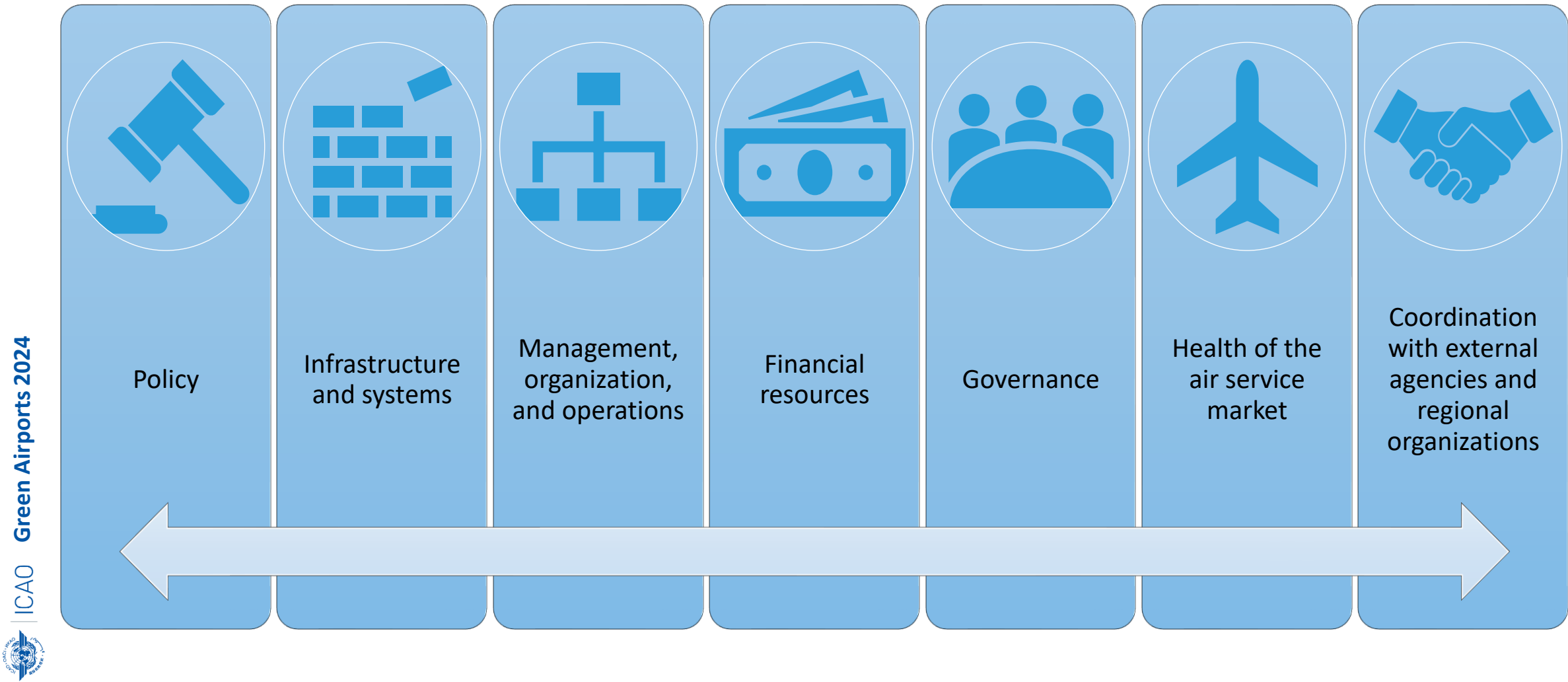
Heightened vulnerability to earthquakes, flooding, and rising sea levels



High dependency on air transport for achieving economic goals

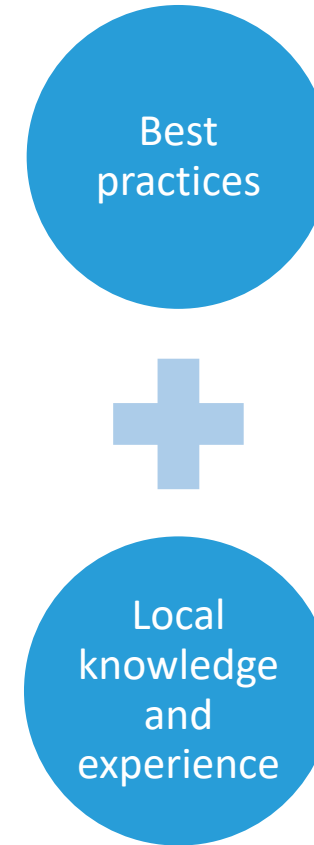


As there is less margin for error, holistically addressing a range of factors is necessary



A collaborative, workshop-driven approach was employed

- Implementation by a World Bank team of experts including expertise in airports, civil aviation, infrastructure vulnerability, and climate change
- A collaborative, workshop-driven approach to leverage local knowledge and expertise and to ensure the relevance of study findings, recommendations, and capacity building activities
- Each study conducted separately (i.e., one for each country) but following a similar approach and leveraging lessons learned across the efforts as much as possible



A 3-step resilience assessment process was used for each country



1. Threats

- * Identify the most important potential disruptive events or trends for the air transport sector
- * Characterize their potential timing and impacts on the sector including consequences for facilities, operations, finances, the economy, and more



2. Gaps

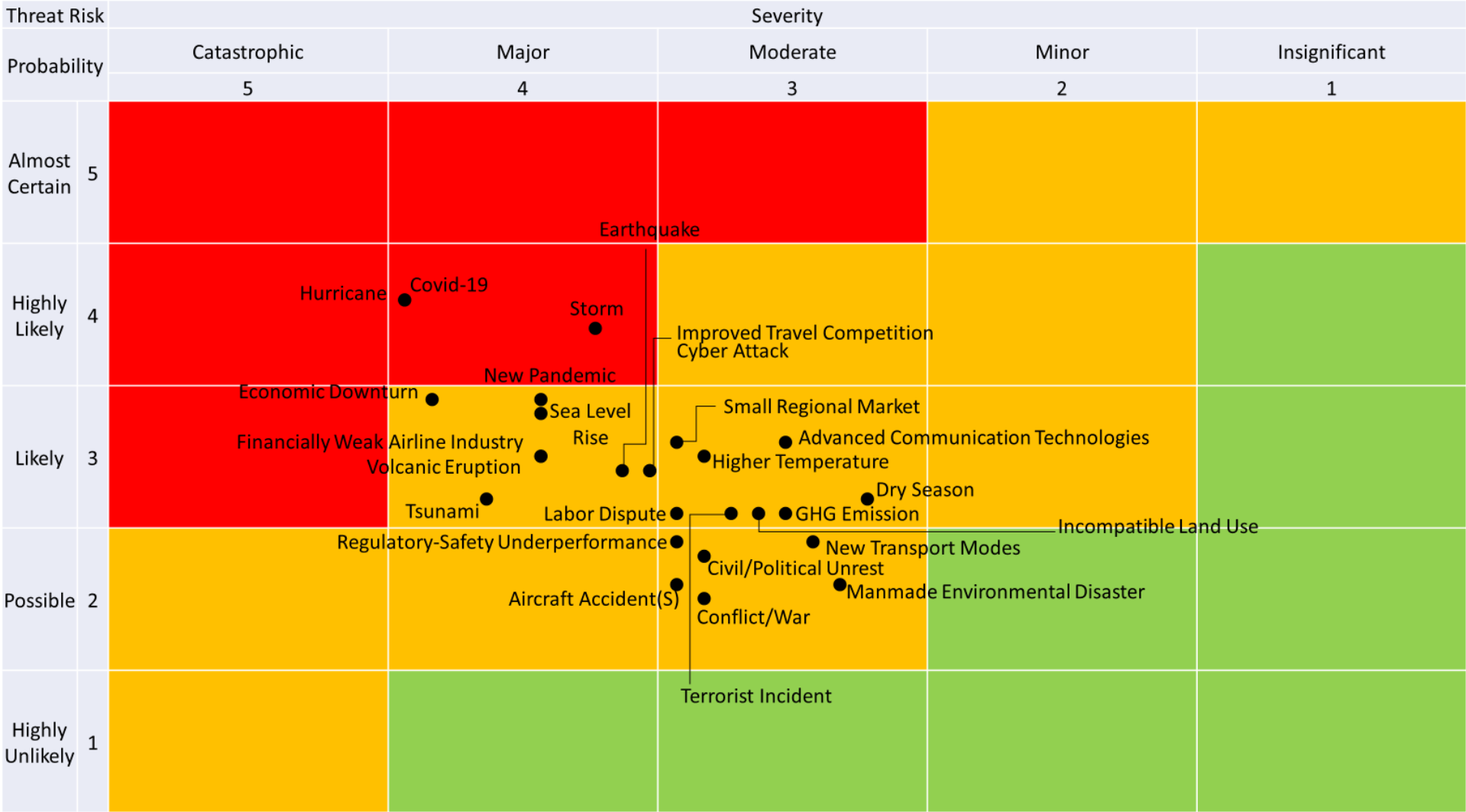
- * Identify critical gaps in current readiness of the air transport sector with a particular focus on airport assets
- * Consider gaps relevant to both “coping with” and “recovering quickly from” a disruptive event or trend



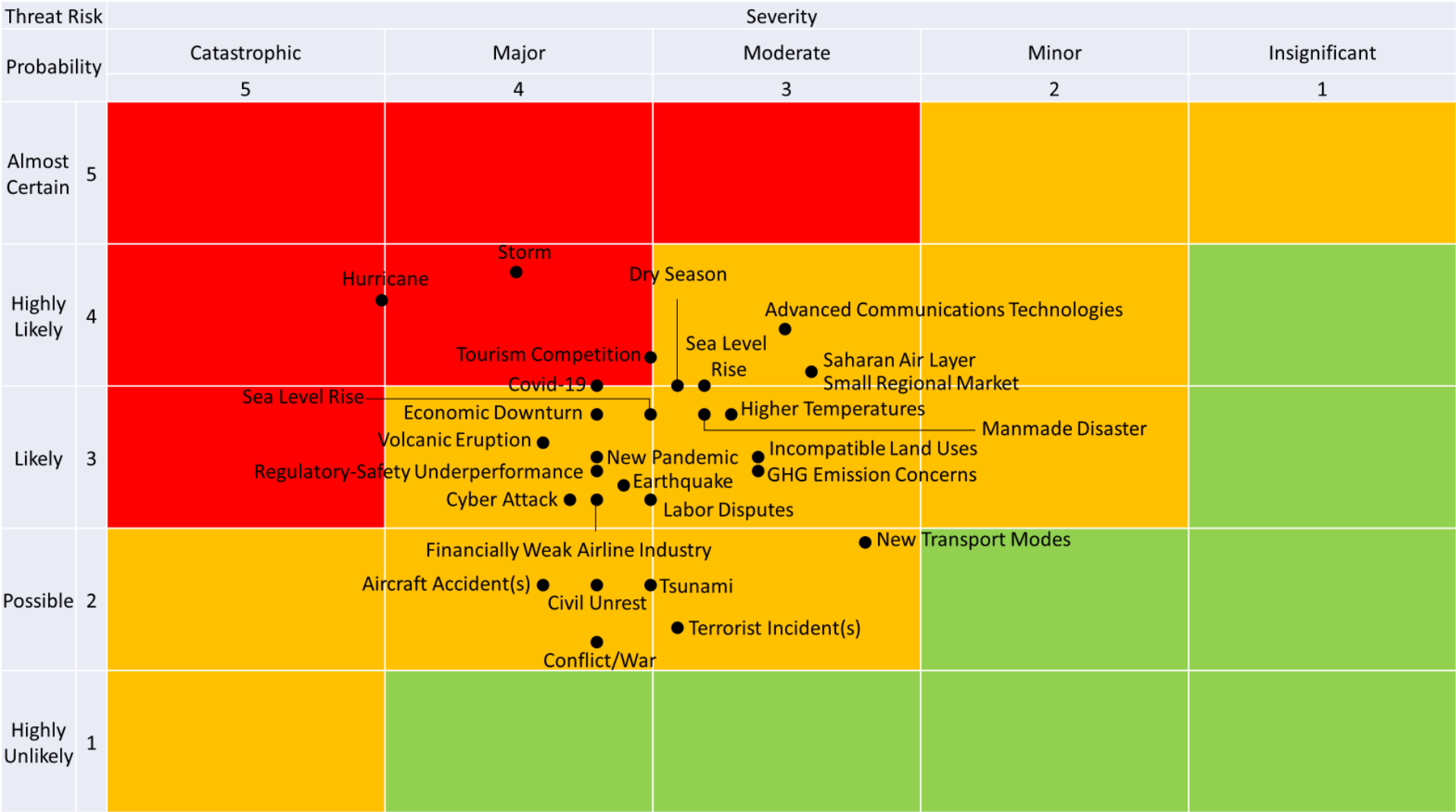
3. Solutions

- * Identify appropriate solutions for closing key resilience gaps including investments in robustness, redundancy, and resourcefulness
- * Identify which solutions have the greatest potential to benefit the air transport sector

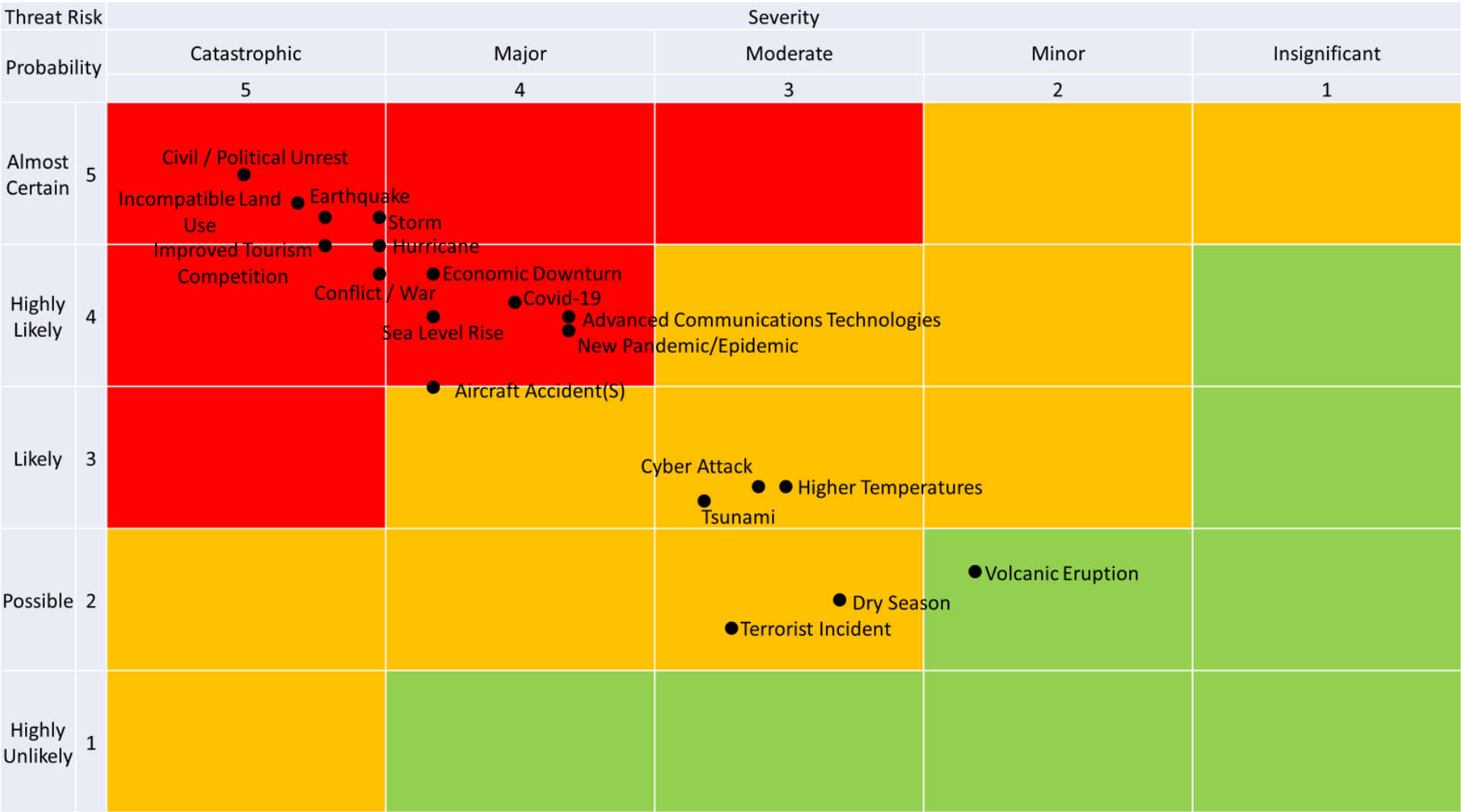
Threat Risk Matrix – Grenada



Threat Risk Matrix – Saint Lucia



Threat Risk Matrix – Haiti



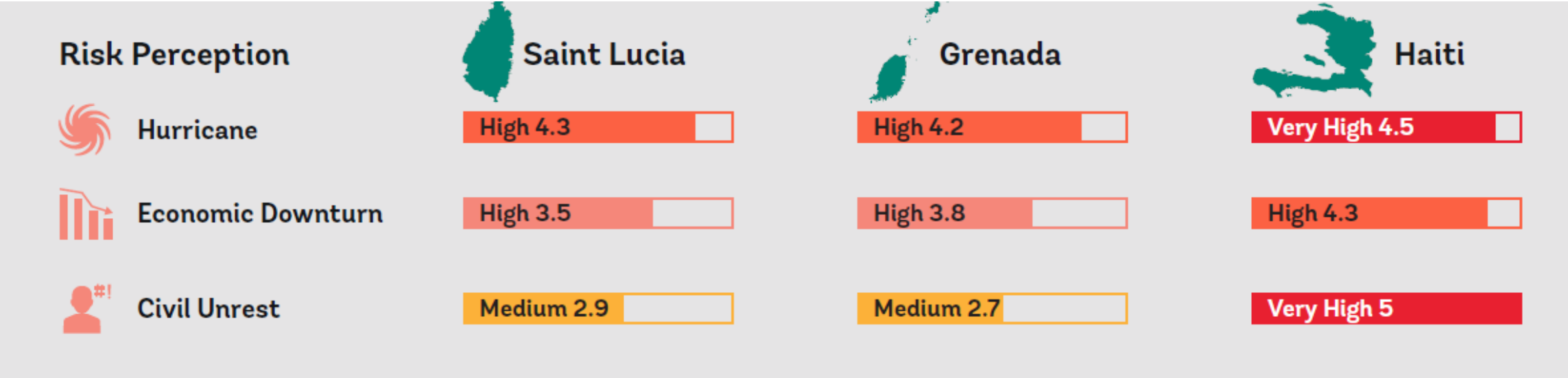
Comparison of Threat Risk Ratings

Threat

Hurricane
Storm
COVID-19
Improved Travel/Tourism Competition
Economic Downturn
Volcanic Eruption
Sea-level Rise
Dry Season
Small Regional Market
Advanced Communications/Collaboration Technologies
Higher Temperatures
Manmade Environmental Disaster
New Pandemic/Epidemic
Regulatory-Safety Underperformance
Cyber Attack
Earthquake
Financially Weak Airline Industry
Saharan Air Layer
Incompatible Land Use
Labor Disputes/Shortages
GHG Emission
Aircraft Accident(s)
Tsunami
Civil/Political Unrest
New Transport Modes/Technologies
Terrorist Incident
Conflict/War

St. Lucia	Grenada	Haiti
18.8	18.6	20.8
17.3	15.0	21.5
13.3	18.7	16.3
13.1	10.5	21.0
12.5	14.9	19.0
12.0	12.1	6.8
11.9	13.0	18.3
11.9	7.9	6.8
11.9	10.9	
11.7	9.9	16.2
11.2	10.6	9.7
11.1	6.3	
11.0	13.7	15.2
10.7	9.3	
10.6	11.0	10.5
10.3	10.7	22.0
10.1	12.0	
10.1		
9.9	9.0	23.5
9.3	9.5	
9.1	8.3	
7.9	7.4	15.3
7.8	11.4	10.0
7.6	7.6	25.0
6.7	8.1	
6.5	9.1	6.8
6.3	6.7	20.3

Risk Perception – Similarities and Differences



General approach to improving air transport resilience across the Caribbean



Make urgent resilience investments in infrastructure and systems



Improve emergency management and recovery



Improve investment identification and prioritization



Optimize the financial performance of the aviation sector



Implement emergency funding mechanisms



Create a high-performance airport management organization with resilience embedded in its mission.



Improve safety oversight and economic regulation of the sector.



Prepare and implement a Resilience Enhancement Implementation Plan (REIP).

Grenada recommendations snapshot:

Critical near-term investments in infrastructure and systems



- Upgrade airport drainage capacity in current and future flood-prone areas based on the outcome of CATCOP-funded SDFRP
- Rehabilitate MBIA's runway and build RESAs
- Install ILS for Runway 10 and implement ADS-B
- Construct permanent resilient cargo facility with upgraded X-ray screening capacity
- Create additional in-terminal space for revenue-generating activities
- Implement an emergency operations center



Grenada recommendations snapshot: Defining a comprehensive Resilience Enhancement Implementation Plan



Conduct coordinated studies, analyses, and audits to (1) define other critical infrastructure and system investments and (2) optimize the financial and operational performance of the sector

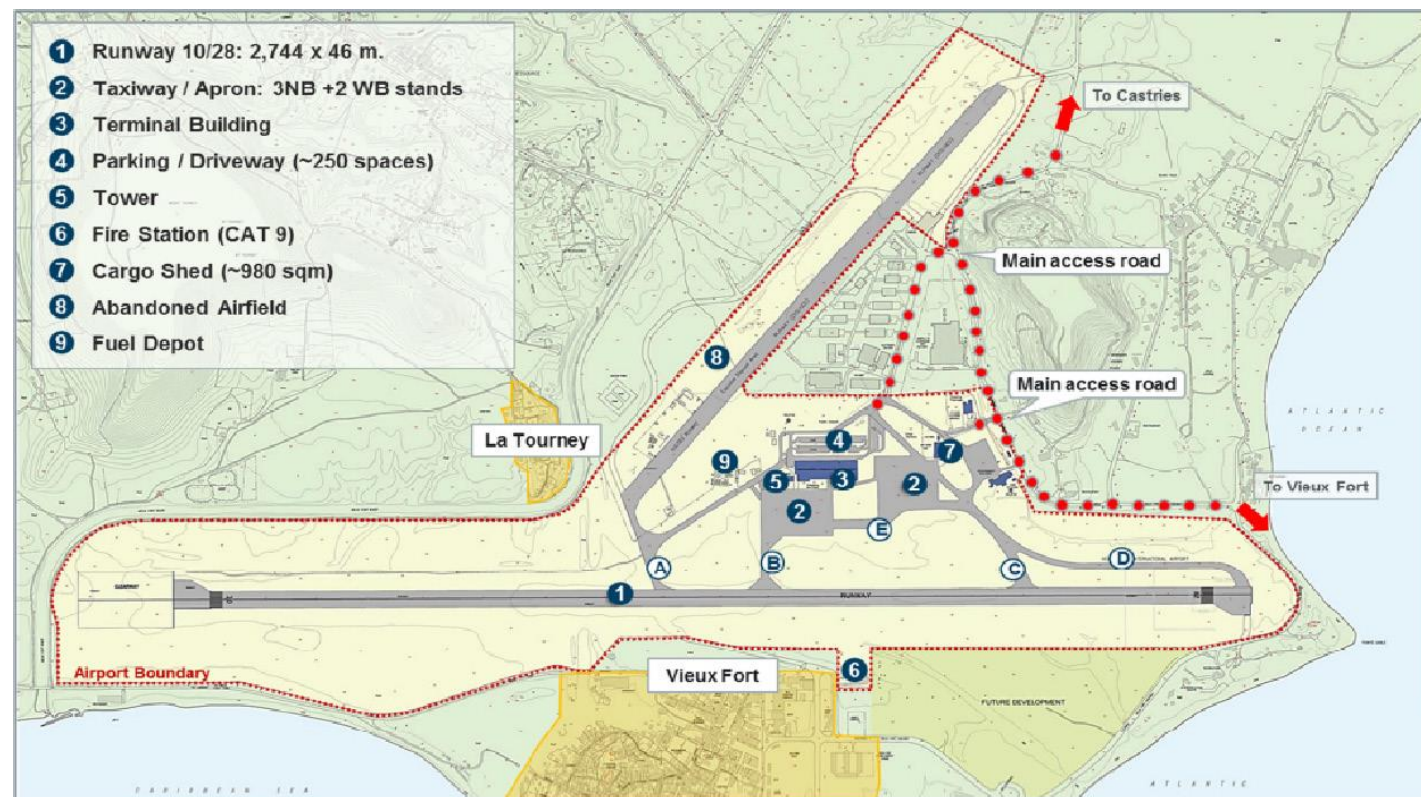


Saint Lucia recommendations snapshot:

Critical near-term investments in infrastructure and systems



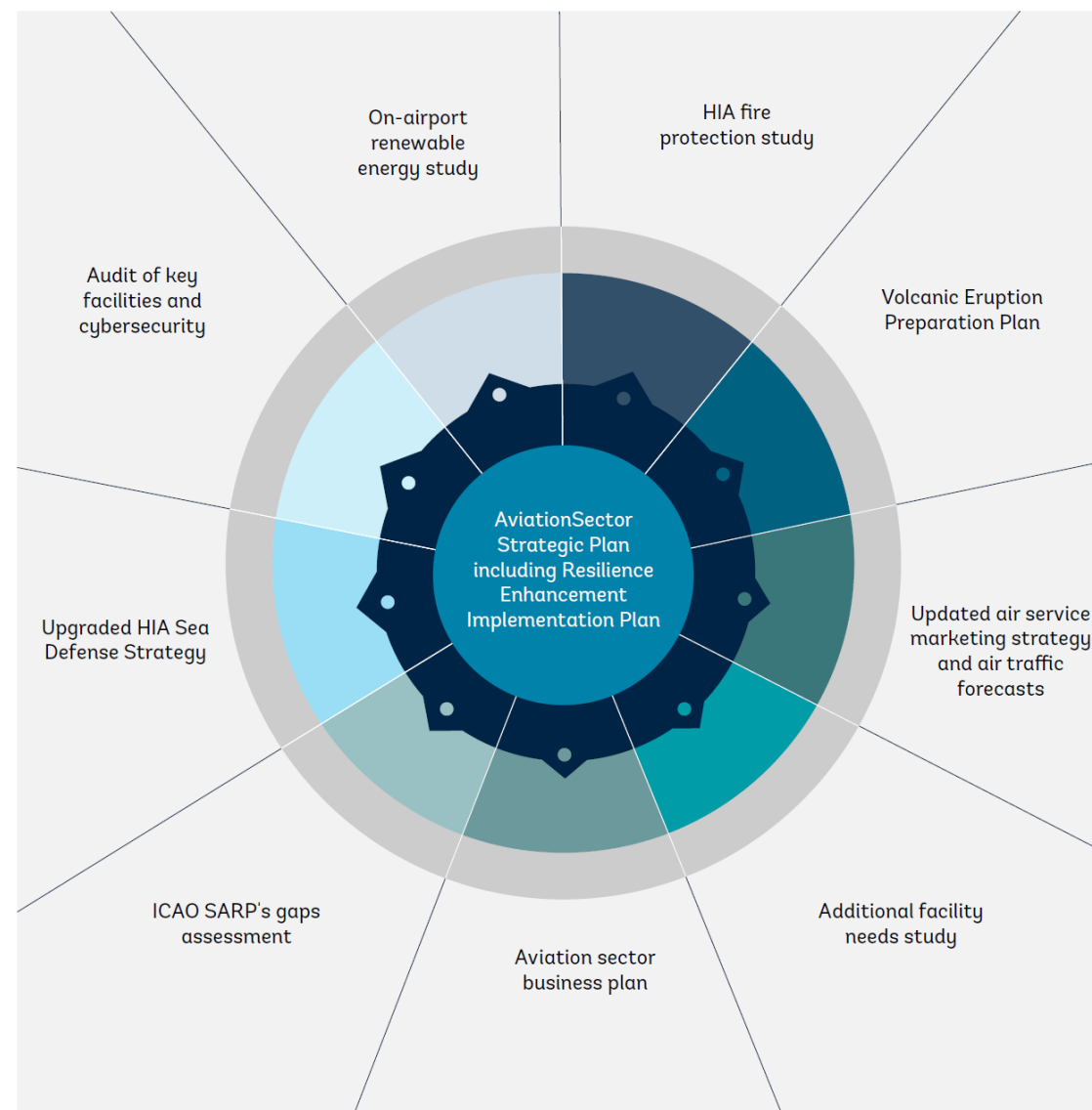
- Upgrade drainage capacity of HIA airfield
- Upgrade HIA's runway, including rehabilitating pavements, building shoulders, and adding RESAs
- Construct turn pad for Runway 10
- Install ILS for Runway 10
- Redevelop CFR control room to provide full runway line-of-sight
- Expand aircraft parking apron at terminal
- Develop modern passenger terminal facilities
- Create additional in-terminal space for revenue-generating activities



Saint Lucia recommendations snapshot: Defining a comprehensive Resilience Enhancement Implementation Plan



Conduct coordinated studies, analyses, and audits to (1) define other critical infrastructure and system investments and (2) optimize the financial and operational performance of the sector



Haiti recommendations snapshot: Critical near-term investments in infrastructure and systems



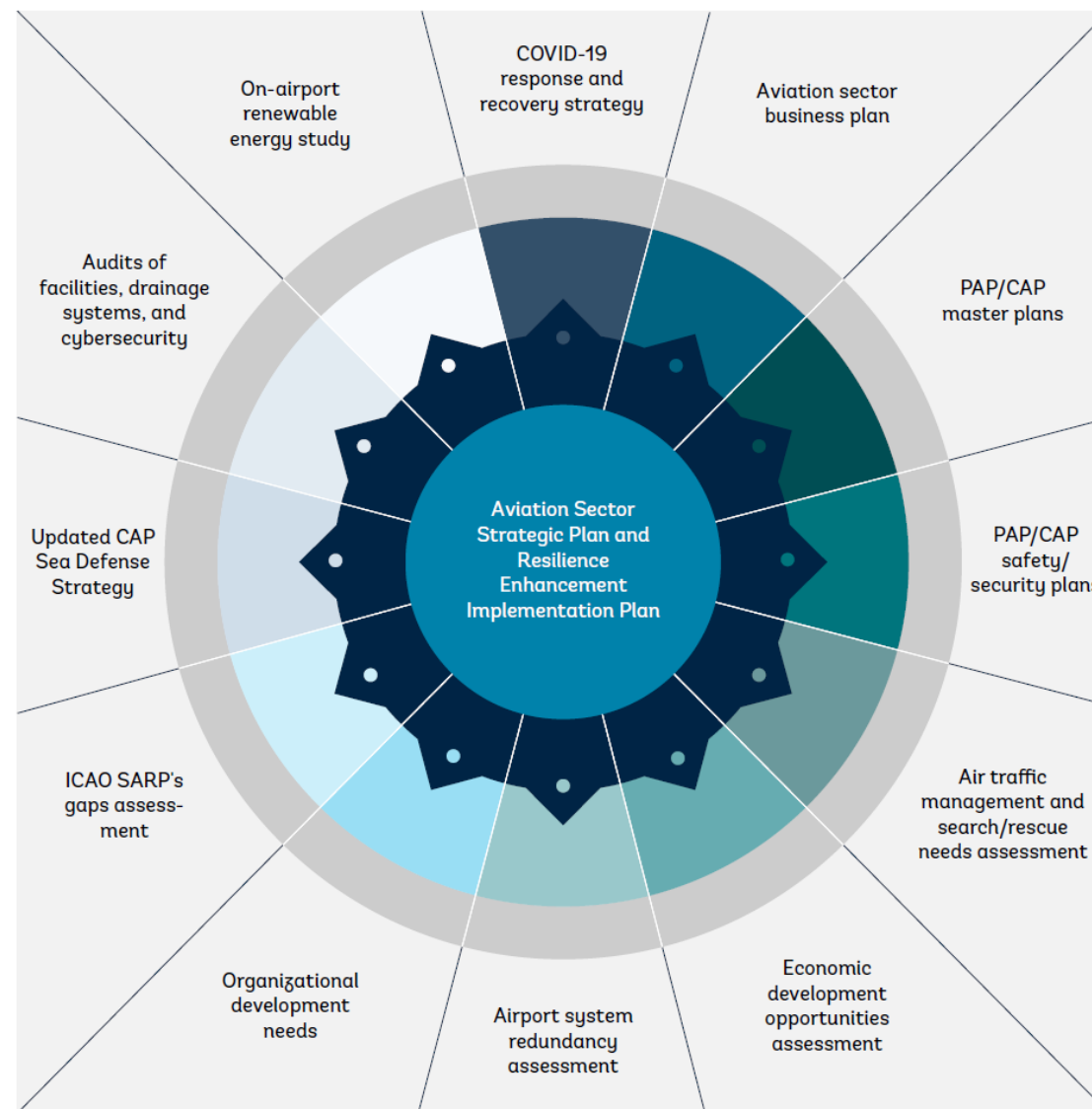
- Upgrade PAP and CAP airfield drainage capacity
- Rehabilitate CAP runway pavement
- Construct permanent/resilient CAP air traffic control tower
- Build RESAs for both ends of the PAP runway
- Implement automatic dependent surveillance-broadcast (ADS-B) for PAP and CAP
- Expand PAP taxiway and apron capacity to meet post-disaster demand surges
- Upgrade perimeter security systems for PAP and CAP
- Upgrade wildlife management program/systems for PAP and CAP



Haiti recommendations snapshot: Defining a comprehensive Resilience Enhancement Implementation Plan



Conduct coordinated studies, analyses, and audits to (1) define other critical infrastructure and system investments and (2) optimize the financial and operational performance of the sector



What's next?

- Many recommendations are being implemented through CATCOP
 - Infrastructure upgrades
 - Additional studies
 - Capacity building
- Given much change over many years will be required to succeed, enduring government engagement and commitment is being sought across the necessary agencies and departments for the full range of recommendations
- CATCOP provides a natural vehicle for the follow-up and other necessary conversations, at least through 2026



Thank You

