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KOCH ENGINEERED SOLUTIONS

Commonwealth of Dominica

Island Resilience Action Challenge (IRAC)
Grid Resilience Cost Gap working group

April 11, 2023

Grid Resilience Cost Gap Team Members

TASK FORCE MEMBERS:

Francine Baron, Commonwealth of Dominica led the Grid Resilience Cost Gap work estimation with her team

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Commonwealth of Dominica-at-a-glance

Key Highlights

- 750 sq kms; population ~72,000
- High mountain area ~4750 ft tall mountain
- Dense population in limited flat regions
- Large hydrothermal/geothermal generation projects
- Needs new 69kV/33kV transmission line
- Nation vulnerable to hurricanes, heavy rains and floods
- Grid resilience cost gap identified as critical next step in May 2022 CREF event

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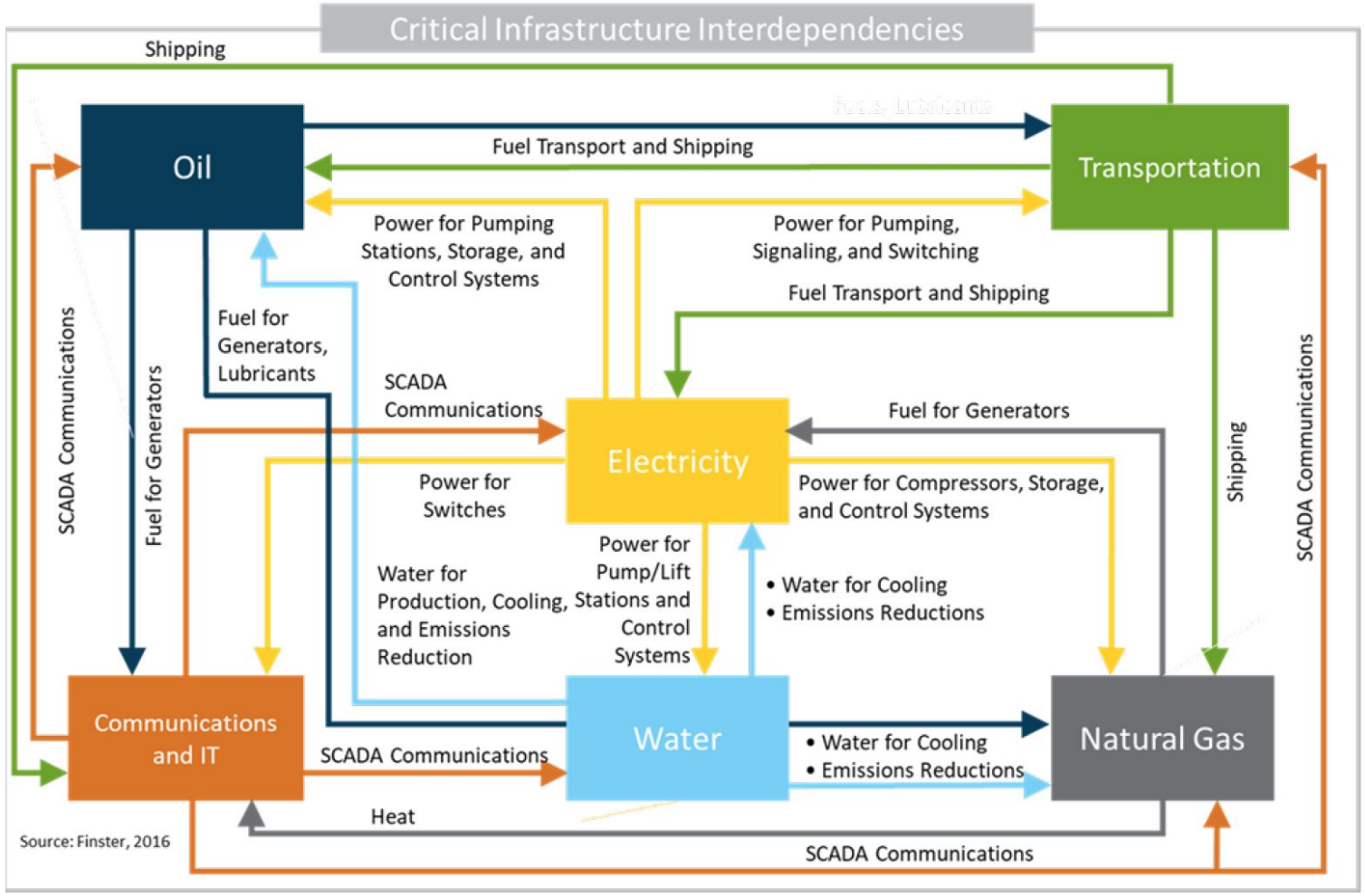
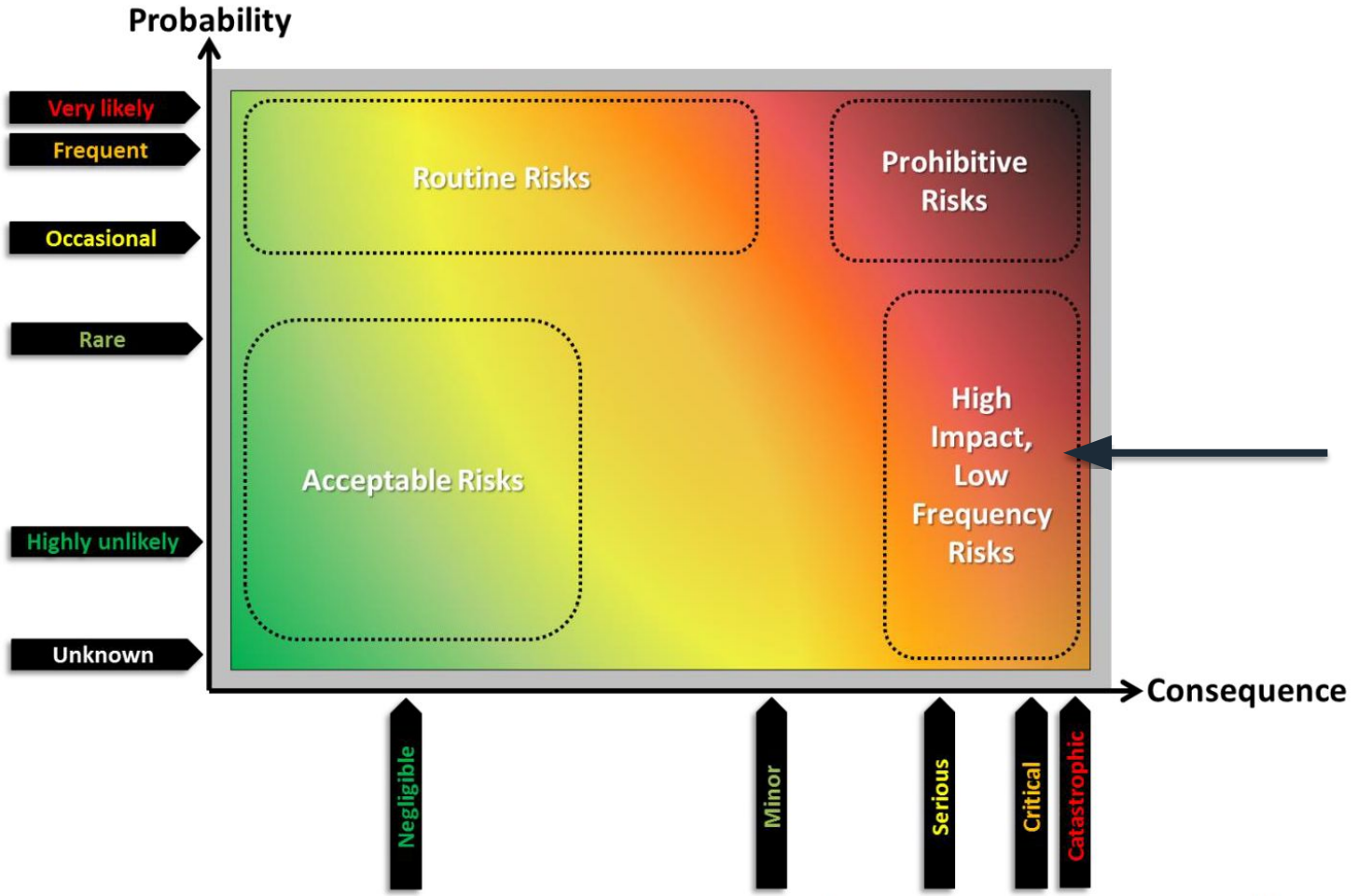
Grid impacts water and other critical infrastructures



Source: M. Finster, Argonne National Laboratory

Grid Resilience Risk Framework Methodology

Figure 4. Conceptual Model of the Risk Landscape



Grid Resilience Cost Gap is HERE

Caption: The risk landscape is formed by the interaction between the probability of threats and their consequences.[18] These axes define different classes of risks that reflect different combinations of probability and consequence.

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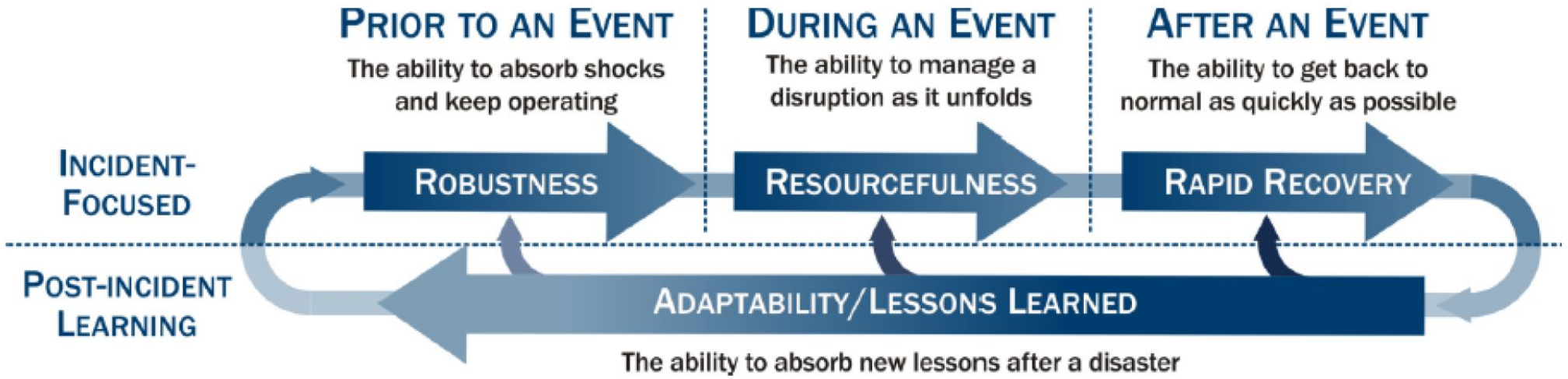
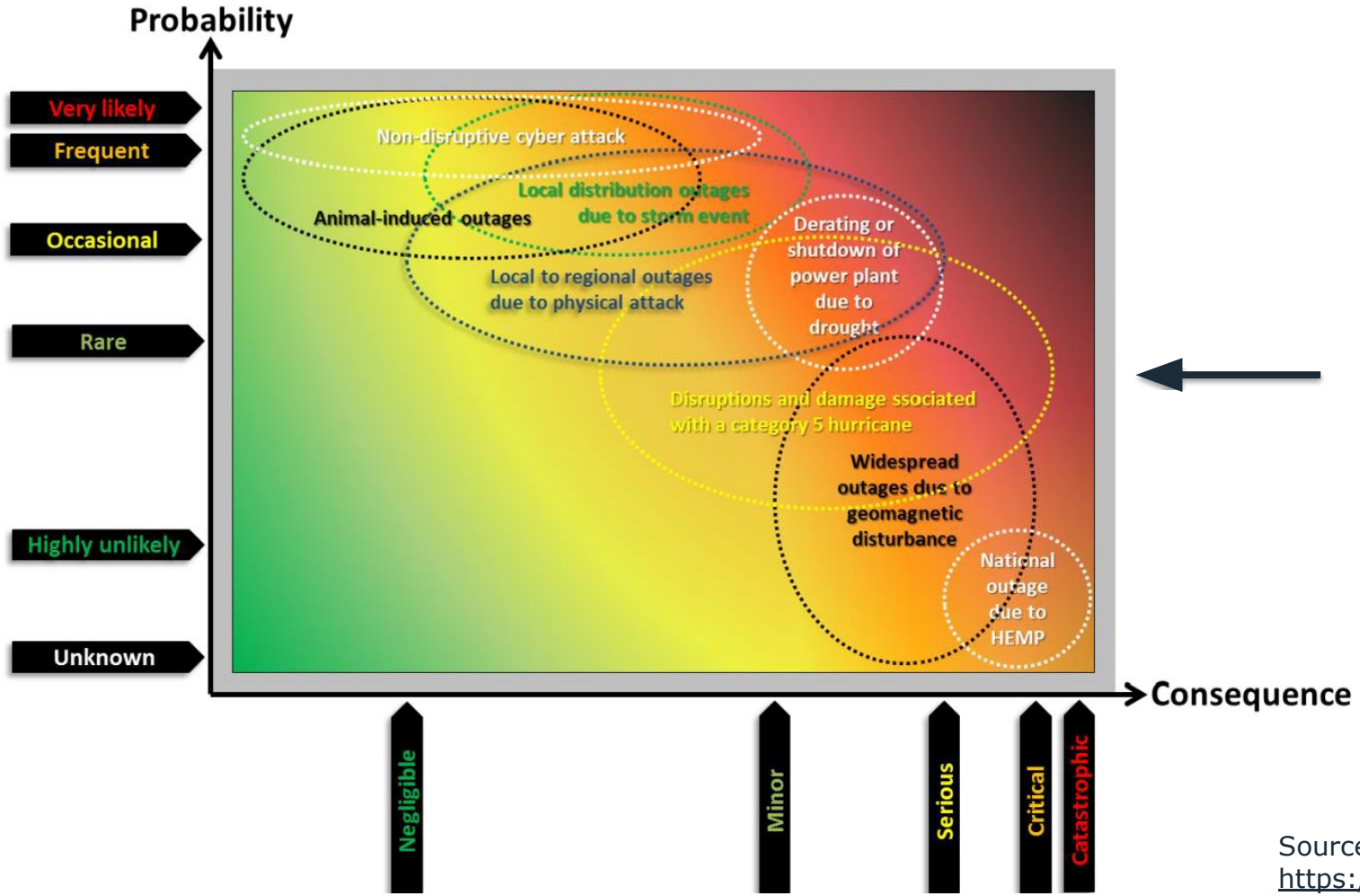
Grid hardening needed to defend against HILF events

- **Limitations; Not everything in grid resilience can be quantified, predicted or even anticipated**
- Growing awareness of robust new approaches to grid resiliency; Focus on **high Impact low frequency** (HILF) events like Hurricanes



Cat 5 Hurricanes are known danger to Dominica

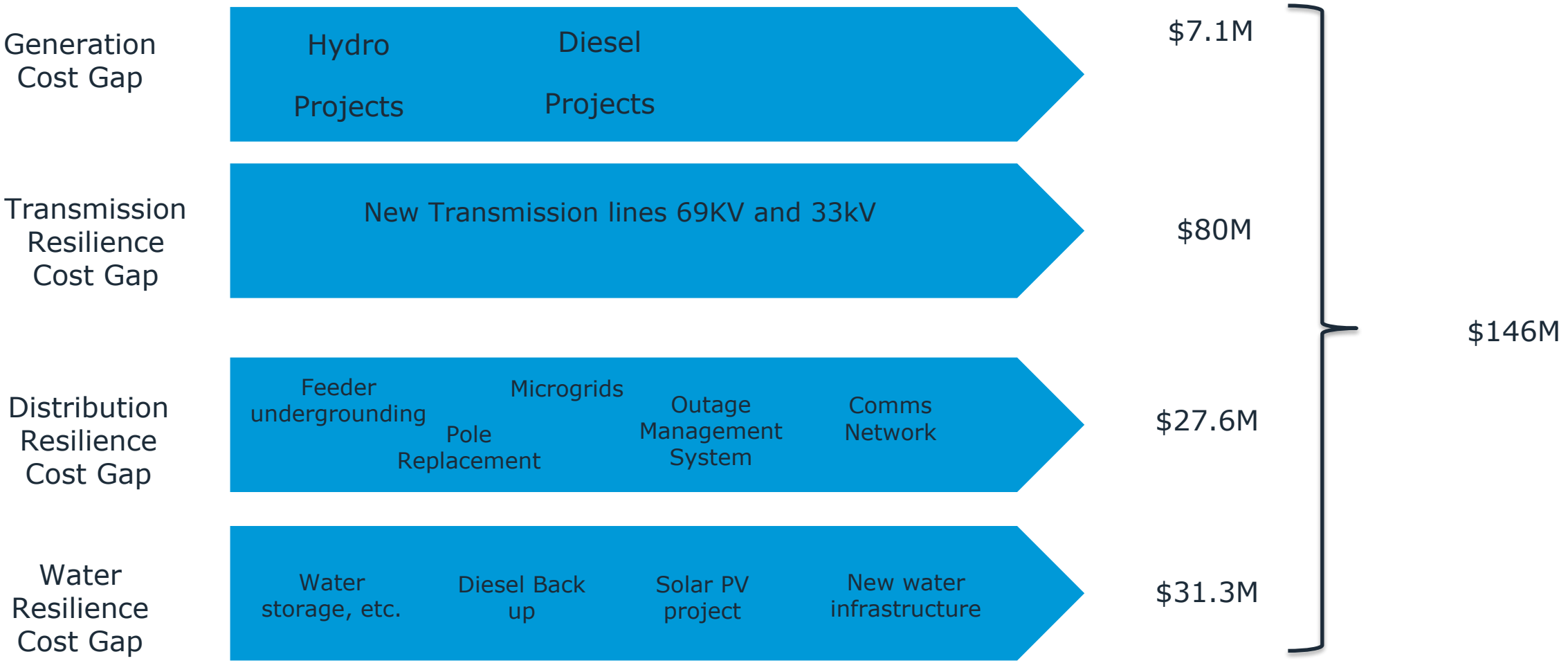


Grid Resilience Risks - Dominica

- ✔ Hurricane/Storms
  - Earthquake
- GDP impacted
- 25th on the list of most vulnerable nations
- 90% of the risk is storms/hurricanes
- Economic impact could be as high as $1.3B for a Cat 5 storm

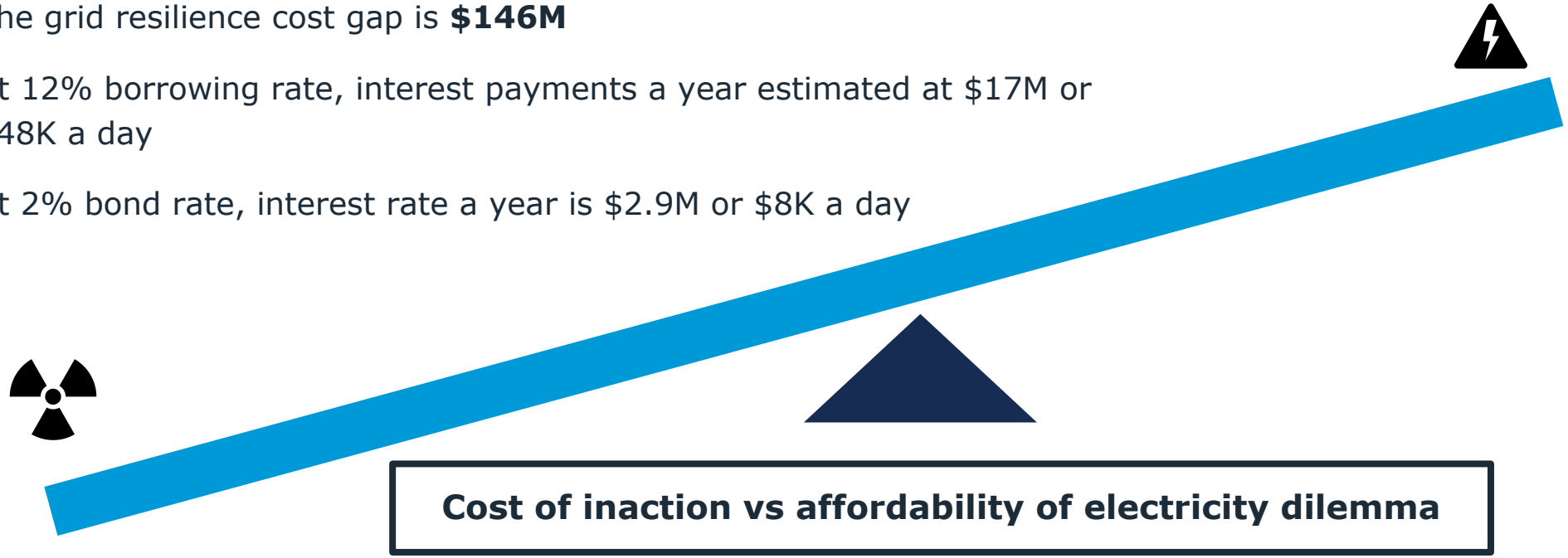
Source: https://climateknowledgeportal.worldbank.org/country/dominica/vulnerability

Dominica Grid Resiliency Costs



Economic ROI to cover Grid Resilience Cost Gap

- The GDP of the commonwealth of Dominica is estimated $600M
- A Cat 5 hurricane could put the whole economy at risk; Hurricane Maria impact was **$1.3B** for Dominica
- The daily GDP impact therefore is **$3.6M**
- The grid resilience cost gap is **$146M**
- At 12% borrowing rate, interest payments a year estimated at $17M or $48K a day
- At 2% bond rate, interest rate a year is $2.9M or $8K a day



Cost of inaction vs affordability of electricity dilemma

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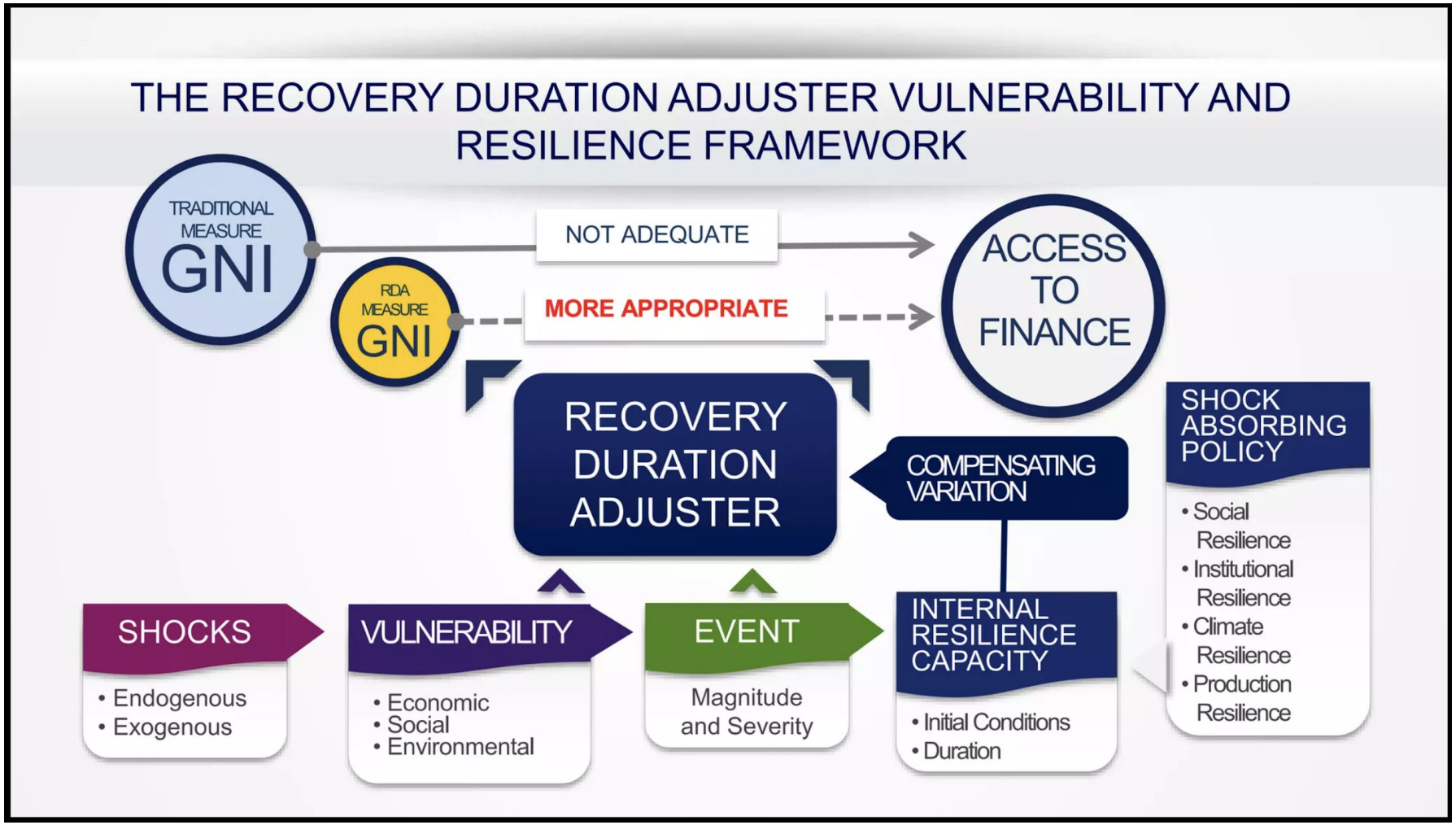
Caribbean Development Bank- Recovery Duration Adjuster



Next Steps

- Present findings at CREF 2023 in Miami

- CREF team to organize facilitated session to engage stakeholders in ideation session
  - trigger innovative ideas to create grass roots awareness of the risks associated with continued vulnerability to hurricanes
  - How to engage external stakeholders to invest in grid resilience
  - Ideas and incentives to overcome the risk of inaction/delay
  - Ideas and incentives to overcome the challenge of affordability
  - What comes next?

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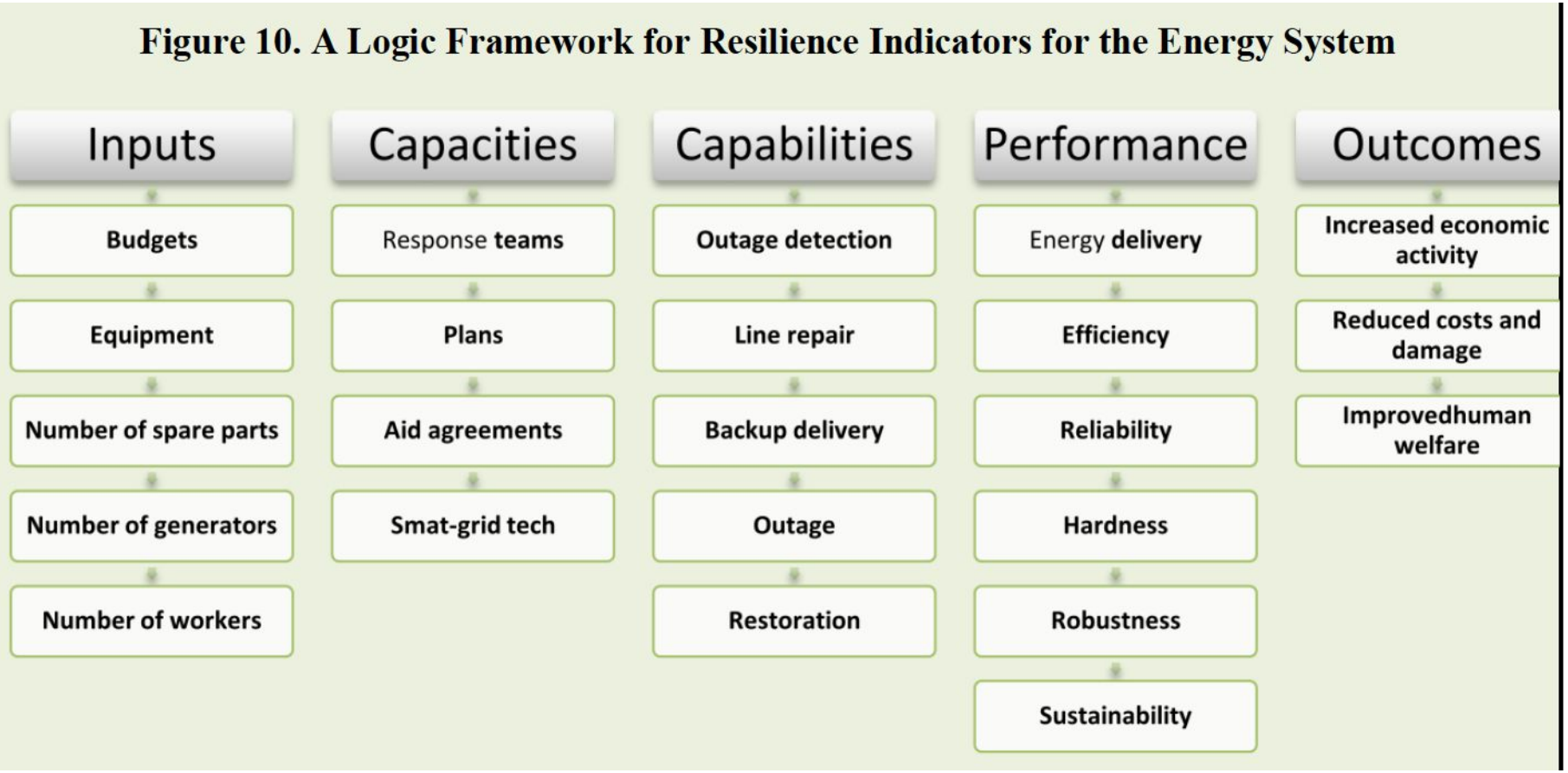
Back Up slides

Component of a Grid Resilience Plan



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Dominica Grid Resilience Baseline Assessment – 2023

Threat	Intensity	Probability	System Components					
			Transmission	Generation	Substation	OH Distribution	UG Distribution	Storage
Hurricane	< category 3	↑↑	○	◑	◑	○	○	◑
	> category 3	↑						
Drought	PDSI <3							
	PDSI >3							
Winter Storm	Low icing threat							
	High icing							
Extreme Heat wave		↑	○	◑	◑	○	○	◑
Flood	1-10 year <ARI	↑↑	○	◑	◑	○	○	◑
	1-100 year <ARI	↑						
Wildfire	Low	↑						
	High							

○ Poor preparedness ◑ Medium ● Robust readiness

Dominica Grid Resilience Baseline Assessment – 2023

Threat	Intensity	Probability	System Components					
			Transmission	Generation	Substation	OH Distribution	UG Distribution	Storage
Sea Level Rise		↑	○	◑	◑	○	○	◑
Earthquake	Low (<5.0)	↑	○	◑	◑	○	○	◑
	High (>7.0)	↑						
Geomagnetic	Low (G1-G2)							
	Medium (G5)	↑						
Wildlife/Veg	Low	↑						
Human Threats	Low/High	↑						
Physical	Low/High	↑						
Cyber	Low/High	↑						
Electromagnetic	Low/High	↑						
Equipment Failure	High	↑	○	◑	◑	◑		
COMBINED THREATS			○	○	○	○	○	○