Welcome to the 65th MEA Conference

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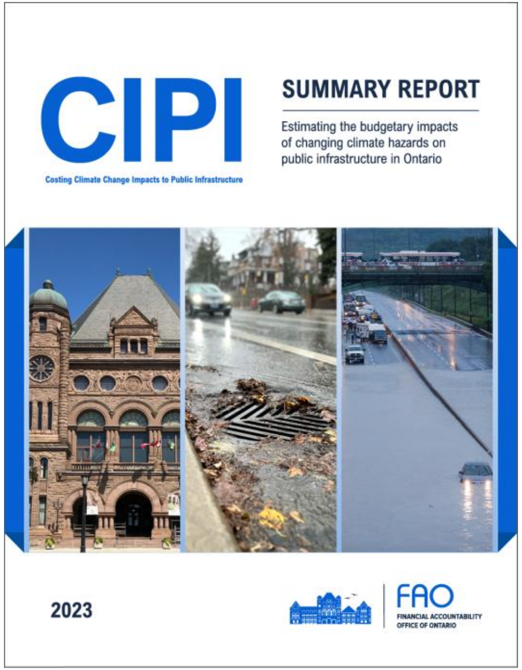
london.ca

Building Sustainable Infrastructure Through Climate Informed Asset Management

Capital Programming Stream

Budgetary Impacts of Climate Change on Public Infrastructure

“The FAO projects that in the absence of adaptation, changing climate hazards will add $4.1B/yr on average to the cost of maintaining the $708 billion portfolio of existing public infrastructure in a medium emissions scenario. This represents a 16% increase..”



Ontario’s 444 municipalities own 71% ($506 billion) of the public infrastructure portfolio in the CIPI project’s scope.

Implications for Public Infrastructure

- Climate hazards are accelerating asset deterioration
- Need for more frequent rehabilitations
- Earlier renewals
- Spending for more operations and maintenance (O&M) activities

- Overflows
- Road closures

- Increased cooling demand
- Water supply shortages
- Pavement softening

- Frozen pipes
- Pavement cracking
- Salt corrosion

- Power outages
- Roof damage
- Debris blocking SWM

O.Reg 588/17 - Climate Change Requirements

Section 3(1) 5, the Strategic Asset Management Policy States:

5. The municipality's commitment to consider as part of its asset management planning,

   i. the actions that may be required to address the vulnerabilities that may be caused by climate change to the municipality's infrastructure assets, in respect of such matters as,

      A. operations, such as increased maintenance schedules,

      B. levels of service, and

      C. lifecycle management,

   ii. the anticipated costs that could arise from the vulnerabilities described in subparagraph i,

   iii. adaptation opportunities that may be undertaken to manage the vulnerabilities described in subparagraph i,

   iv. mitigation approaches to climate change, such as greenhouse gas emission reduction goals and targets, and

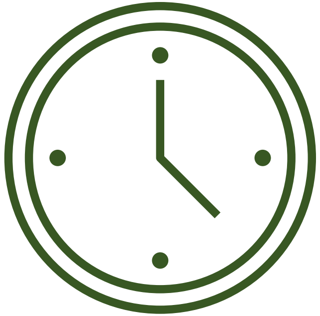
   v. disaster planning and contingency funding.

Client Request

How do we really understand the cost of climate change on our infrastructure?

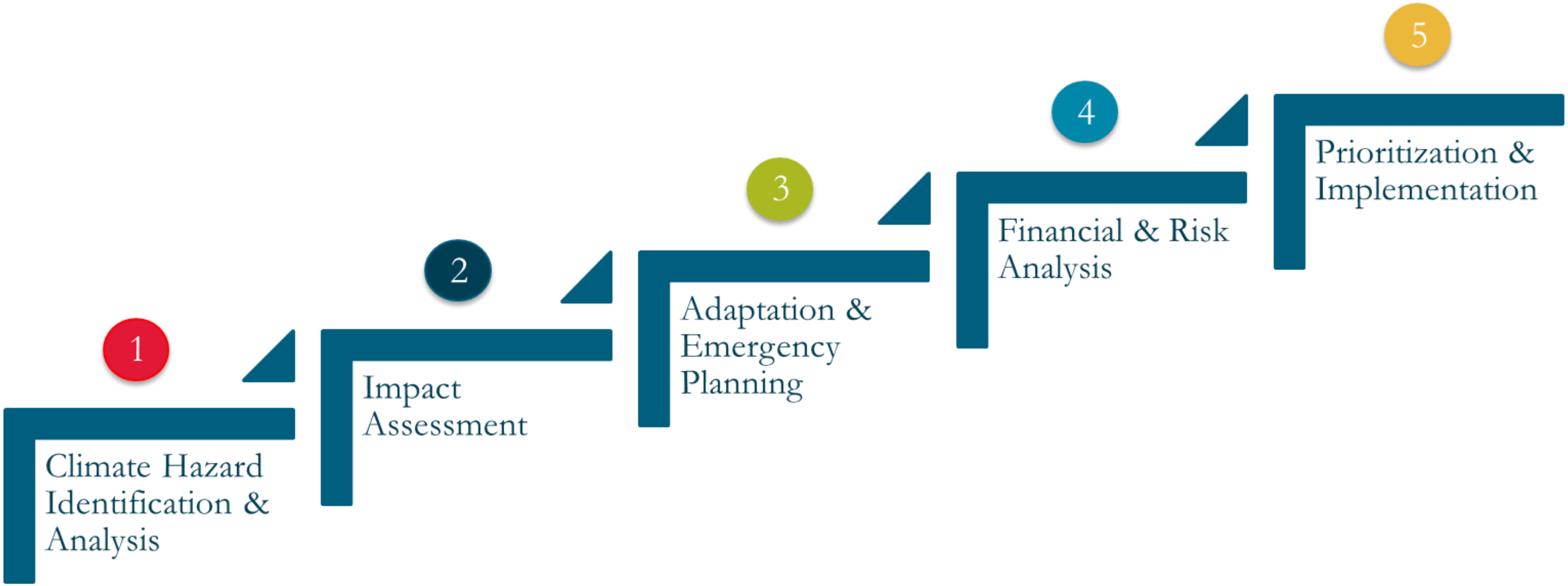
Cost of Climate Impacts on Infrastructure

Cost of Adaptation Options



Implementation Options

Climate-Informed Asset Management Framework



Climate Hazard Identification & Analysis

Objective: Understand current and future climate risks affecting infrastructure

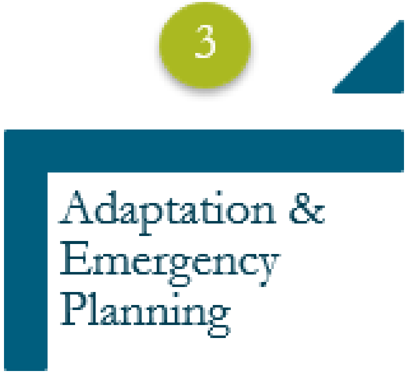
- Use local climate projections (e.g., extreme rainfall, heatwaves, drought, freeze-thaw)
- Analyze hazard likelihood and intensity for different future time periods (2050s & 2080s).
- Apply multi-model datasets to capture full range of risk scenarios (mid and high emission scenarios)

Impact Assessment

Objective: Assess how climate-related events impact assets

- Evaluate how identified hazards affect asset lifecycle and performance
- Assess potential service level disruptions and condition deterioration
- Identify vulnerabilities across asset classes (e.g., roads, water, facilities)
- Establish baseline for climate sensitivity of infrastructure systems

Adaptation & Emergency Planning



Objective: Plan for resilience and response

- Assign appropriate adaptation strategies (e.g., upgrades, design changes)
- Develop or refine emergency response procedures where adaptation isn't feasible
- Integrate climate considerations into maintenance planning
- Ensure continuity of service and community safety under stress scenarios

Financial & Risk Analysis

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Financial & Risk Analysis

Objective: Model costs and benefits of action vs inaction

- Quantify long-term asset performance under future climates
- Calculate avoided costs from adaptation vs. the status quo
- Evaluate financial risks, service disruption costs, and risk reduction benefits
- Use decision-support modeling tools (DSS) to guide planning

Prioritization & Implementation

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Prioritization & Implementation

Objective: Drive climate-smart investment decisions

- Prioritize adaptation actions based on risk reduction and cost-effectiveness
- Align strategies with enterprise asset management systems
- Integrate into long-range capital planning and budget cycles
- Advance projects that optimize lifecycle costs and community resilience

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What Does This Framework Look like in Action?

Building for Tomorrow LONDON 2025

Climate Hazard Identification

No.	Climate Change Hazard[1]	Occurring …	Climate Parameter(s) and Threshold(s) (Climate Change Event)[1]	Trend	Historical (1981-2010) Annual Occurrence (events/yr)[3]	Historical (1981-2010) Probability of Occurrence in One Year	Historical (1981-2010) Return Period (Historically)[4]	2030s Timeline (2011-2040) Annual Occurrence (events/yr)	2030s Timeline (2011-2040) Probability of Occurrence in One Year	2030s Timeline (2011-2040) Return Period (Early Century)	2050s Timeline (2041-2070) Annual Occurrence (events/yr)	2050s Timeline (2041-2070) Probability of Occurrence in One Year	2050s Timeline (2041-2070) Return Period (Mid-Century)	2080s Timeline (2071-2100) Annual Occurrence (events/yr)	2080s Timeline (2071-2100) Probability of Occurrence in One Year	2080s Timeline (2071-2100) Return Period (End of Century)
1	Extreme Rain	Annual	10-year return period (55 mm over 6 hour time period)	↑	0.100 events/yr	10%	10 year event	0.129 events/yr	13%	8 year event	0.155 events/yr	15%	6 year event	0.194 events/yr	19%	5 year event
2	Extreme Rain	Annual	25-year return period (65 mm over 6 hour time period)	↑	0.040 events/yr	4%	25 year event	0.052 events/yr	5%	19 year event	0.072 events/yr	7%	14 year event	0.092 events/yr	9%	11 year event
3	Extreme Rain	Annual	50-year return period (73 mm over 6 hour time period)	↑	0.020 events/yr	2%	50 year event	0.022 events/yr	2%	45 year event	0.035 events/yr	4%	28 year event	0.046 events/yr	5%	22 year event
4	Extreme Rain	Annual	1 in 100-year return period event (80 mm over 6 hour time period)	→	0.010 events/yr	1%	100 year event	0.011 events/yr	1%	123 year event	0.015 events/yr	2%	66 year event	0.020 events/yr	2%	49 year event
5	Drought	Annual	14 consecutive days where precipitation is 0mm	↑	1.248 events/yr	100%	0.84 year event	1.155 events/yr	100%	0.87 year event	1.334 events/yr	100%	0.74 year event	1.552 events/yr	100%	0.65 year event
6	Freezing Rain	Winter (DJFM)	Days where precipitation over 55mm and max temp <0C	→	0.002 events/yr	0.2%	480 year event	0.002 events/yr	0.2%	480 year event	0.002 events/yr	0.2%	480 year event	0.004 events/yr	0.40%	240 year event
7	Rain on Snow	Winter (DJFM)	Number of days with a maximum daily temperature above 0°C and a minimum temperature below 0°C, and precipitation is 20mm or more	→	0.995 events/yr	97%	1.03 year event	1.113 events/yr	100%	0.92 year event	1.029 event/yr	100%	1.01 year event	0.911 event/yr	91%	1.13 year event
8	Freeze-thaw	Annual	Number of days with a maximum daily temperature above 0°C and a minimum temperature below 0°C	↓	78.832 events/yr	100%	0.01 year event	75.929 events/yr	100%	0.01 year event	67.292 events/yr	100%	0.02 year event	57.140 events/yr	100%	0.02 year event
9	Extreme Heat	Summer (JJA)	Days where maximum air temperature is more 32°C	↑	3.870 events/yr	100%	0.36 year event	10.003 events/yr	100%	0.11 year event	22.516 events/yr	100%	0.05 year event	44.323 events/yr	100%	0.02 year event
10	Extreme Heat	Summer (JJA)	Days where maximum air temperature is more 40°C	↑	0.566 events/yr	57%	1.77 year event	0.671 events/yr	67%	1.49 year event	0.805 events/yr	81%	1.24 year event	1.084 events/yr	100%	0.92 year event
11	Extreme Heat - Heat Wave	Annual	3 consecutive days >32 °C during the day and Tropical Nights (Days with Tmax > 32C; Days with Tmin >22 °C during the night)	↑	0.030 events/yr	<1%	>250 year event	0.204 events/yr	4%	23.12 year event	2.053 events/yr	100%	0.86 year event	9.560 events/yr	100%	0.14 year event
12	High Winds[2]	Annual	Wind gusts exceed 63km/hr	→	12.3 events/yr	100%	0.08 year event	12.3 events/yr	100%	0.08 year event	12.3 events/yr	100%	0.08 year event	13.5 events/yr	100%	0.07 year event
13	Lake Levels[2]	Annual	Water levels exceed height of Peel's lowest outfall at 75.21 m IGLD	↑	1.0 event/yr In the past 10 years, it was exceeded in: 2011, 2015, 2017, 2018, 2019	100%	1 year event	2.1 events/yr	100%	0.5 year event	3.7 events/yr	100%	0.3 year event	10.6 events/yr	100%	0.09 year event

Documenting Climate Impacts

2

Extreme Heat & Drought

Use the sticky notes to comment, provide context or add ideas related to how precipitation affects the condition, management or service delivery related to assets shown.

10 minutes

A question mark indicates there is a gap in published data as to whether the hazard affects the asset.

Icons indicate published data indicates the hazard may affect the asset.
Do you agree? Why or why not?

Drought Extreme Heat

Asset Class	Do these precipitation hazards affect the asset ?	If yes, provide comments on how the asset is affected (use the sticky notes). If no, indicate why in your response.
Long Term Care Facilities		Extreme temperature fosters thermal expansion of materials affecting the building performance
Long Term Care Centers Site Elements		Extreme heat impact the asphalt and concrete elements
High Density Affordable Housing		
Medium Density Affordable Housing		Extreme high temperature fosters thermal expansion of materials affecting the building performance
[redacted]		Extreme heat impacts tenant occupants, increases AC frequency
		older central HVAC systems not designed to support higher temps; Extreme heat impact the asphalt and concrete elements
		older central HVAC systems not designed to support higher temps; asphalt damaged by extreme heat, softening causing uneven surfaces
		older central HVAC systems not designed to support higher temps
		Extreme heat impact the asphalt and concrete elements

1

Precipitation (Extreme Rainfall; Snow)

Use the sticky notes to comment, provide context or add ideas related to how precipitation affects the condition, management or service delivery related to assets shown.

20 minutes

A question mark indicates there is a gap in published data as to whether the hazard affects the asset.

Icons indicate published data indicates the hazard may affect the asset.
Do you agree? Why or why not?

Rainfall Snow

Asset Class	Do these precipitation hazards affect the asset ?	If yes, provide comments on how the asset is affected (use the sticky notes). If no, indicate why in your response.
Long Term Care Facilities		Flooding at the facilities during high rain event, impacting the performance of the asset; Increased likelihood of molds around leaks in LTC facility during heavy rainfall event, affecting the condition of asset; Extreme rainfall results in erosion of porous materials and corrosion.; Sump pump failure resulted in flooding during heavy rainfall; Backed up drains result in flooding both on the interior and exterior of facilities during heavy rainfall
Long Term Care Centers Site Elements		Extreme rain exceeds the capacity of drainage system and leads to flooding, water infiltration or increased erosion; some catchbasins have failing asphalt and water drains through rather than into the storm system; In locations with limited snow storage, vendors are paid to remove the snow more frequently with multiple days of snow events; freezing rain damage to trees and some perennials; UV deterioration, walls and interior can be damaged when elements get inside (flooding, extreme heat/sun); freezing rain froze heat pumps, needed thaw cycle before they could start
High Density Affordable Housing		Extreme rain and snow lead to disruption of transport infrastructure and hence access to the housing facility
Medium Density Affordable Housing		Extreme rain and snow lead to disruption of transport infrastructure and hence access to the housing facility; Increased likelihood of molds around leaks in building during heavy rainfall event, affecting the condition of asset
[redacted]		
		Extreme rain and snow lead to disruption of transport infrastructure and hence access to the housing facility; snowmelting equipment sometimes get taxed during intense snow events
		Extreme rain and snow lead to disruption of transport infrastructure and hence access to the housing facility; gutters blocked by debris or tree roots in older neighborhoods, causing slow draining and water backup; snow not cleared between surface parking spots or in driveway resulting in difficulty for some residents to get their cars out during snow buildup
		Extreme rain and snow lead to disruption of transport infrastructure and hence access to the housing facility; Extreme humidity impact the structure if cracks in the material are present especially in the exposed components where water accumulation is most likely; In locations with limited snow storage, vendors are paid to remove the snow more frequently with multiple days of snow events; eavestroughs damaged by ice buildup, or ice buildup causing impeded water

Adaptation Options & ERPs

Options: Grey, Green, Blue, Hybrid

Roof	Road	Parking lot
• Green roof • Blue roof • Upsizing downspouts/ drainage	• Heat resilient road mix • Permeable mixes	• Sunshades • Solar panel shades

Quantifying Climate Change

Two Streams of Assessment:

Service Life Reduction (Baseline Stream)

- Estimate how climate change reduces estimated service life (ESL) of assets.
- Increased reinvestment needs as assets require more replacements.

Adapted Asset Replacement (Adaptation Stream)

- Estimate the cost of upgrading to adapted assets (e.g., blue or green roofs).
- Compare cost and benefit of investing in climate-adapted infrastructure.
- This stream supports cost-benefit comparisons and prioritization of adaptation investments.

Example

Service Life Reduction (Baseline Stream)

- Estimate how climate change reduces estimated service life (ESL) of assets.
- Increased reinvestment needs as assets require more replacements.

Status Quo
ESL: 25 years, $5M
Spend over 100 years= $20M

With Climate Impacts
Reduced ESL 20 years, $5M
Spend over 100 years=$25M

Cost of Climate Change= $5M

Case Study – Scenario Modelling

Adapted Asset Replacement (Adaptation Stream)

- Estimate the cost of upgrading to adapted assets (e.g., blue or green roofs).
- Compare cost and benefit of investing in climate-adapted infrastructure.
- This stream supports cost-benefit comparisons and prioritization of adaptation investments.

Extreme Rain

IMPACT:

Water pooling on roofs causing leaks & damage.

Adaptation Strategy 1

Install smart blue roof system

Adaptation Cost= $365/m2

Adapted Asset Lifecycle= 1.5*current lifecycle

Adaptation Strategy 2

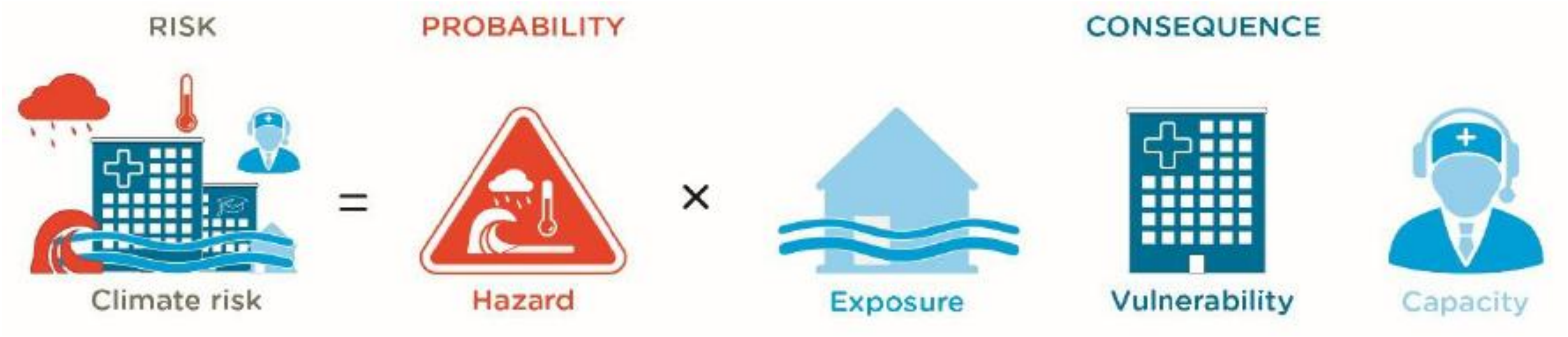
Install green roof system

Adaptation Cost= $460/m2

Adapted Asset Lifecycle= 2*current lifecycle

Additional Modeling Inputs

- Incorporating climate risk and dollar/risk reduction
- % of assets expected to not meet LoS (didn't assume every hazard meant the failure of all assets)



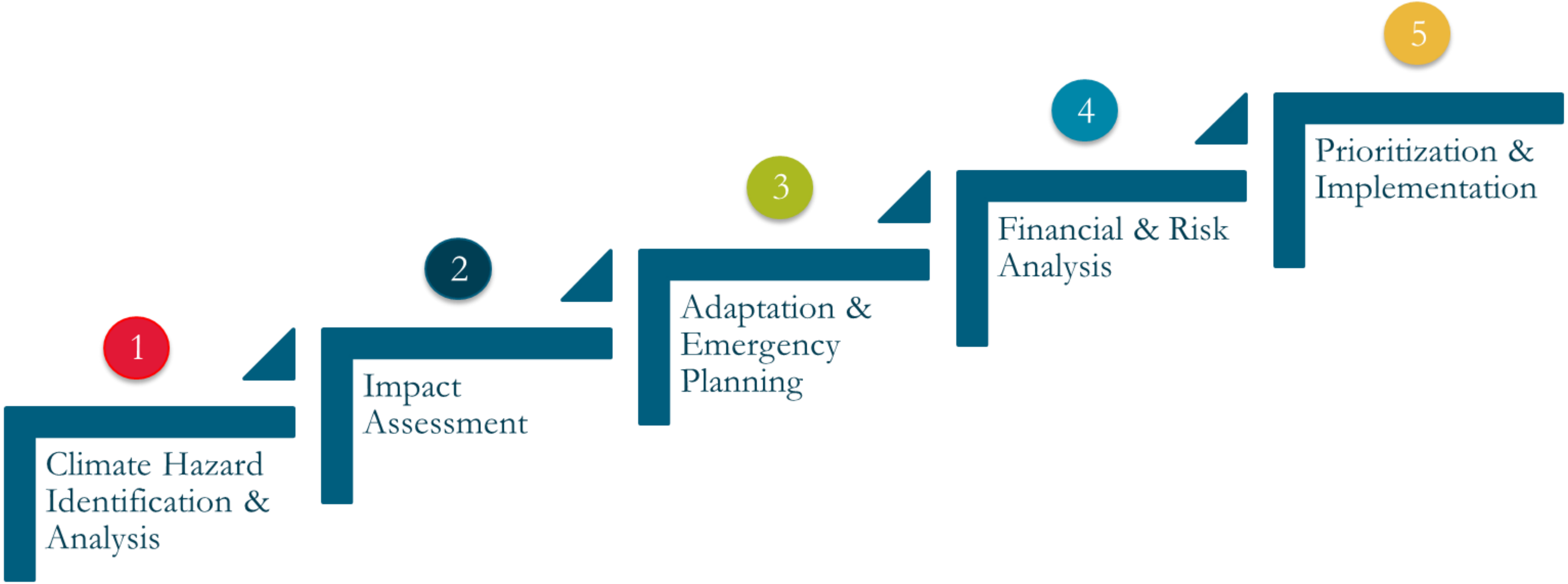
Prioritization

Compare of the cost of different adaptation strategies

Understand where adaptation gives the biggest return on risk reduction

Visually map facilities against climate hazards

Climate-Informed Asset Management Framework



Thank You

Questions?

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