


Infrastructure Climate Risk : Strategies and Tools

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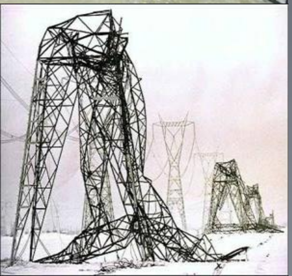
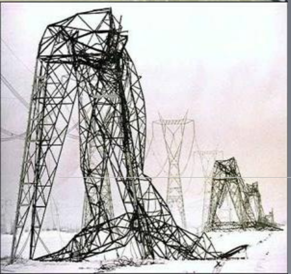
Canada PIEVC CVIIP engineerscanada ingénieurscanada



Accounting for climate change in civil infrastructure

- Low levels of awareness (this is changing)
- Gap between climate science and local planning (this is improving)
- Uncertainties affect willingness to take action
- Available tools/initiatives have focused on mitigation through GHG reduction (but this is evolving)
- Limited examples of comprehensive adaptation strategies and tools (but this is changing)
- Competing priorities and no sense of urgency



What is the concern with infrastructure and changing climate?

- Existing infrastructure has normally been designed using historical climate data
- Past climate not a good indicator of future climate
- Infrastructure designed using historical climate data will not be sufficiently resilient for its service life in the future climate
- Increasing occurrence of extreme weather events causing damage and destruction with high cost to repair and replace


August 2005 Storm - Toronto
Photos courte
Jane-Finch.c


2 High Pressure Gas Mains
Broken Water main
Broken Maintenance Hole
Bell Canada cables
Bell Canada cables
Parks Path
Toronto Hydro and Rogers Cable

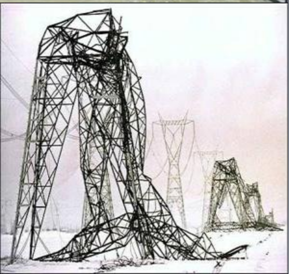
Replacement stream crossing

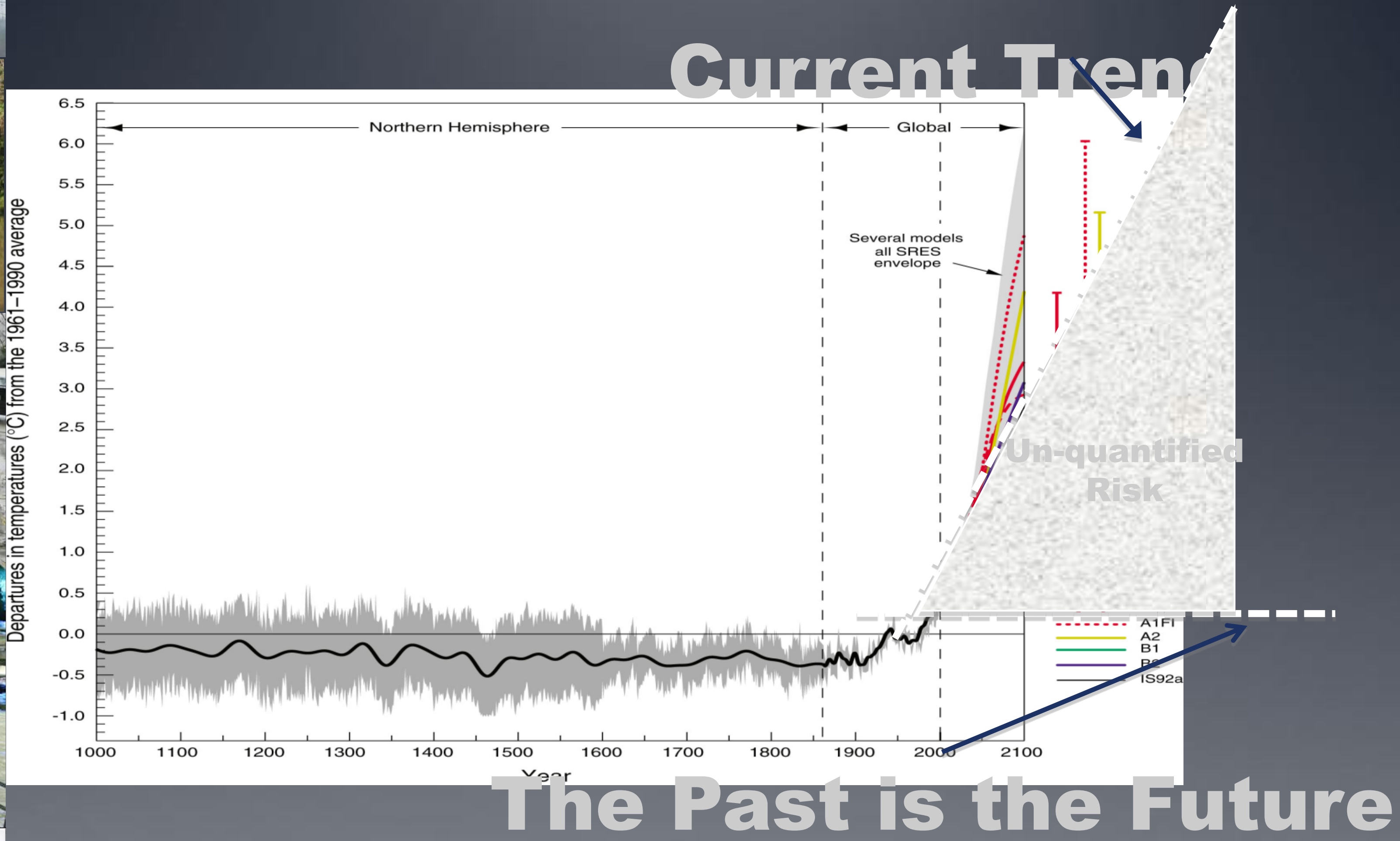
Planning Infrastructure for Changing Climate Strategy #1: Design and Service Life Considerations

Structures	**Expected Lifecycle**
Houses/ Buildings	Retrofit/alterations 15-20 yrs Demolition 50-100 yrs
Storm/Sanitary Sewer	Base system 100 yrs Major upgrade 50 yrs Components 25 – 50 yrs
Dams/ Water Supply	Base system 50-100 yrs Refurbishment 20-30 yrs Reconstruction 50 yrs
Roads & Bridges	Road surface 10 - 20 yrs Bridges 50 - 100 yrs Maintenance annually Resurface concrete 20-25 yrs Reconstruction 50-100 yrs

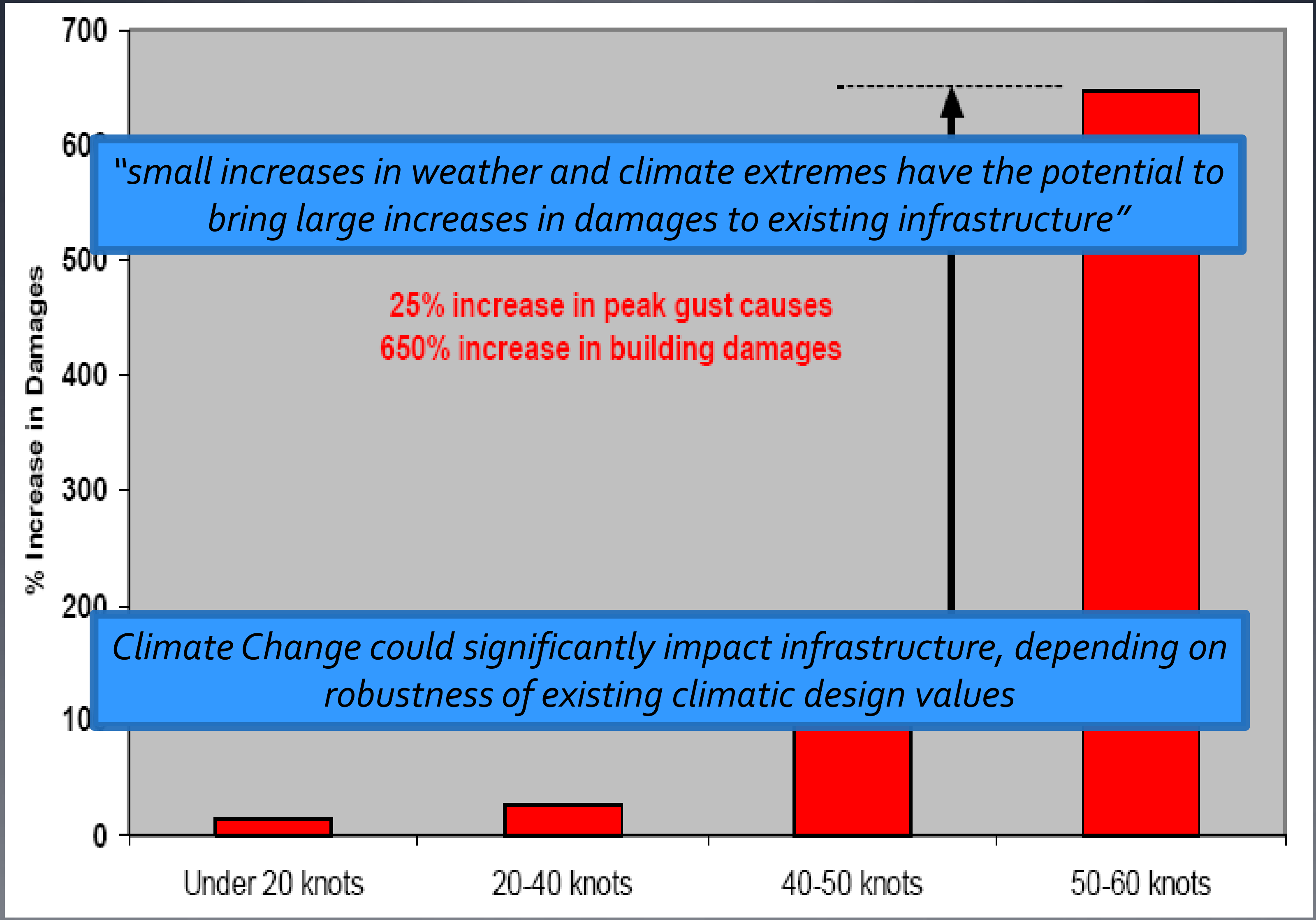
- Design life varies
- Component-based vulnerability assessment
- Safety / economics / technical
- There is adaptive capacity and resilience because of maintenance & rehabilitation
- Conversely, poor maintenance and lack of rehabilitation contributes to vulnerability

Strategy #2:The Past IS NOT the Future





Small Increases = More Infrastructure Damage

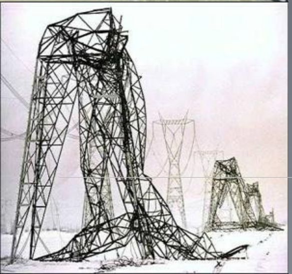


"small increases in weather and climate extremes have the potential to bring large increases in damages to existing infrastructure"

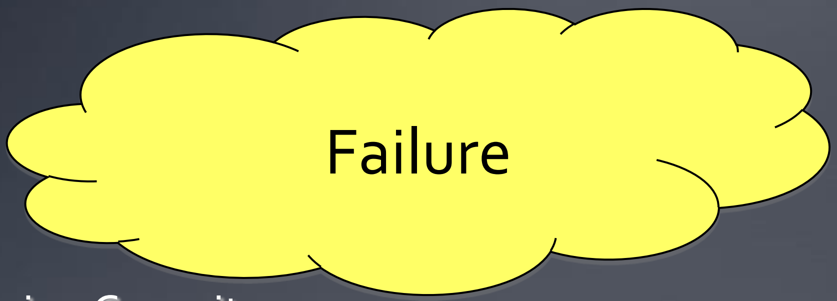
Climate Change could significantly impact infrastructure, depending on robustness of existing climatic design values







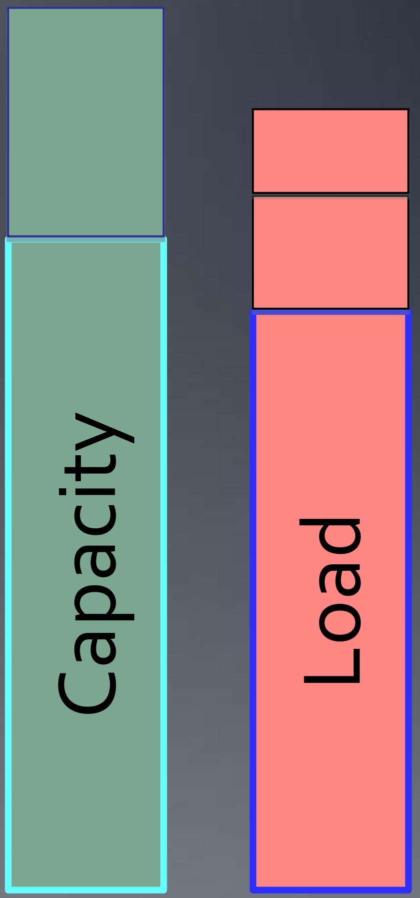
How do Small Changes in Climate Lead to Catastrophic Failure?????

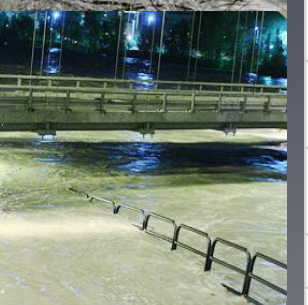


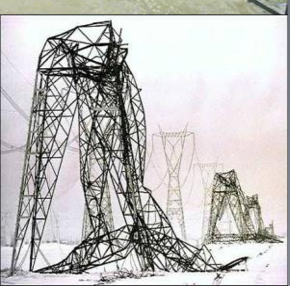
- Design Capacity
- Safety Factor
- Impact of age on structure
- Impact of unforeseen weathering

- Design Load
- Change of use over time
  - For example – population growth

- Severe climate event







Strategy #3: Climate Change Risk Mitigation through Adaptation

7	SEVERITY	Catastrophic 0.800	[illegible]	7	14	21	28	[illegible]	[illegible]	49
6		Hazardous 0.400	[illegible]	6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	42
5		Serious 0.200	0	5	10	15	20	25	30	35
4		Major 0.100	0	4	8	12	16	20	24	28
3		Moderate 0.050	0	3	6	9	12	15	18	21
2		Minor 0.025	0	2	4	6	8	10	12	14
1		Measurable 0.0125	0	1	2	3	4	5	6	7
0		No Effect	0	0	0	0	0	0	0	0
			negligible or not applicable	improbable 1:1 000 000	remote 1:100 000	occasional 1:10 000	moderate 1:1 000	probable 1:100	frequent 1:10	continuous 1:1
			PROBABILITY							
			0	1	2	3	4	5	6	7

Flood

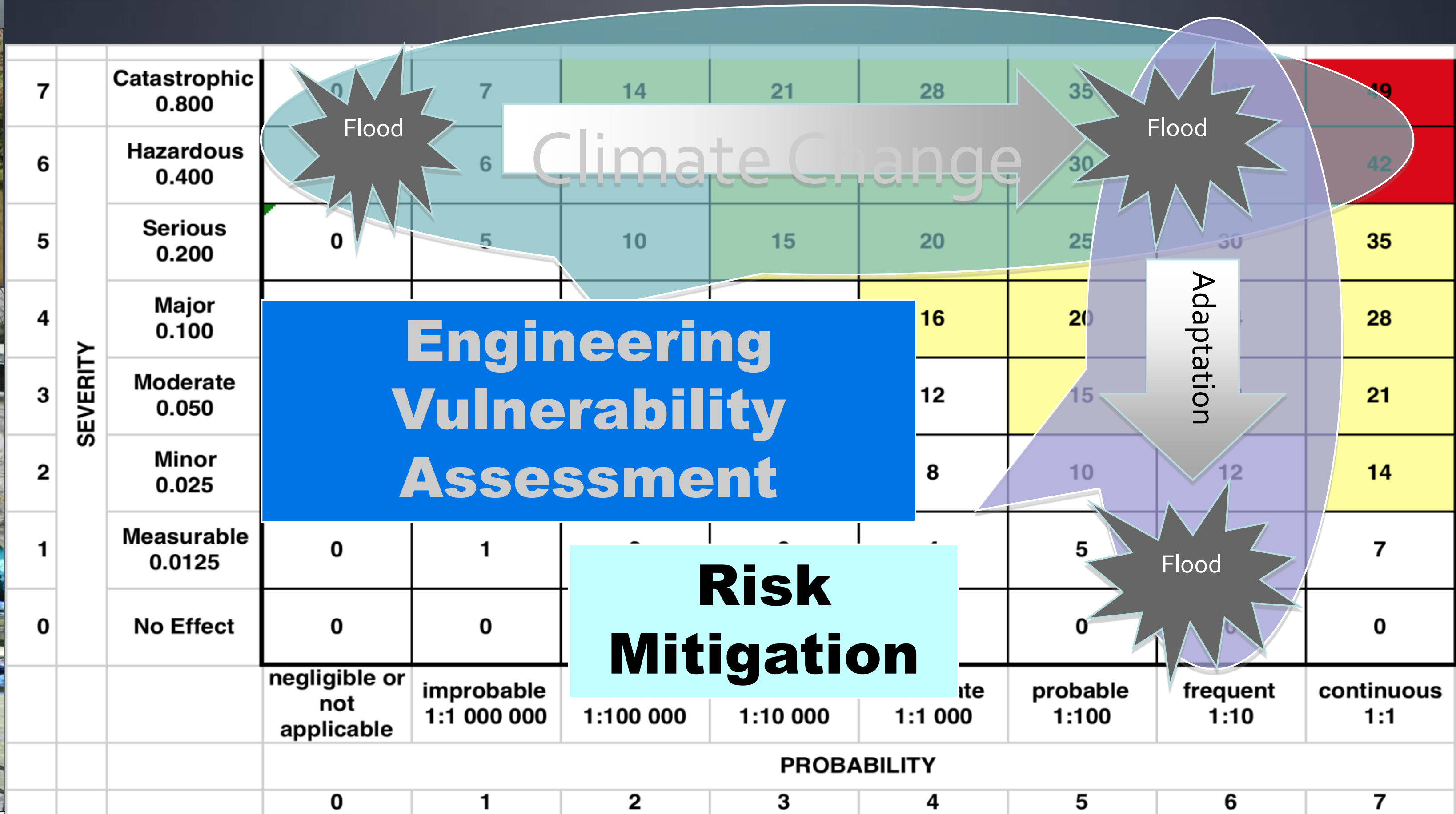
Climate Change

Flood

Adaptation

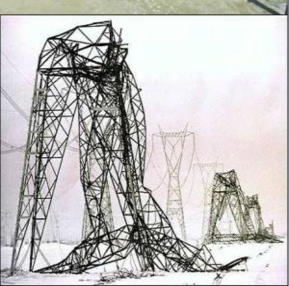
Flood

Strategy #3: Vulnerability Assessment and Risk Mitigation







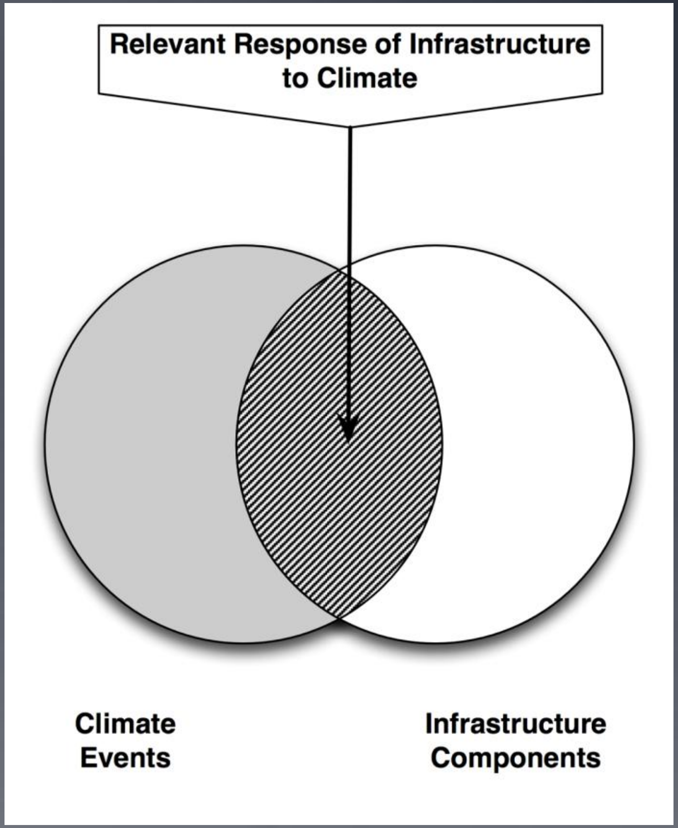


Public Infrastructure Engineering Vulnerability Committee (PIEVC)

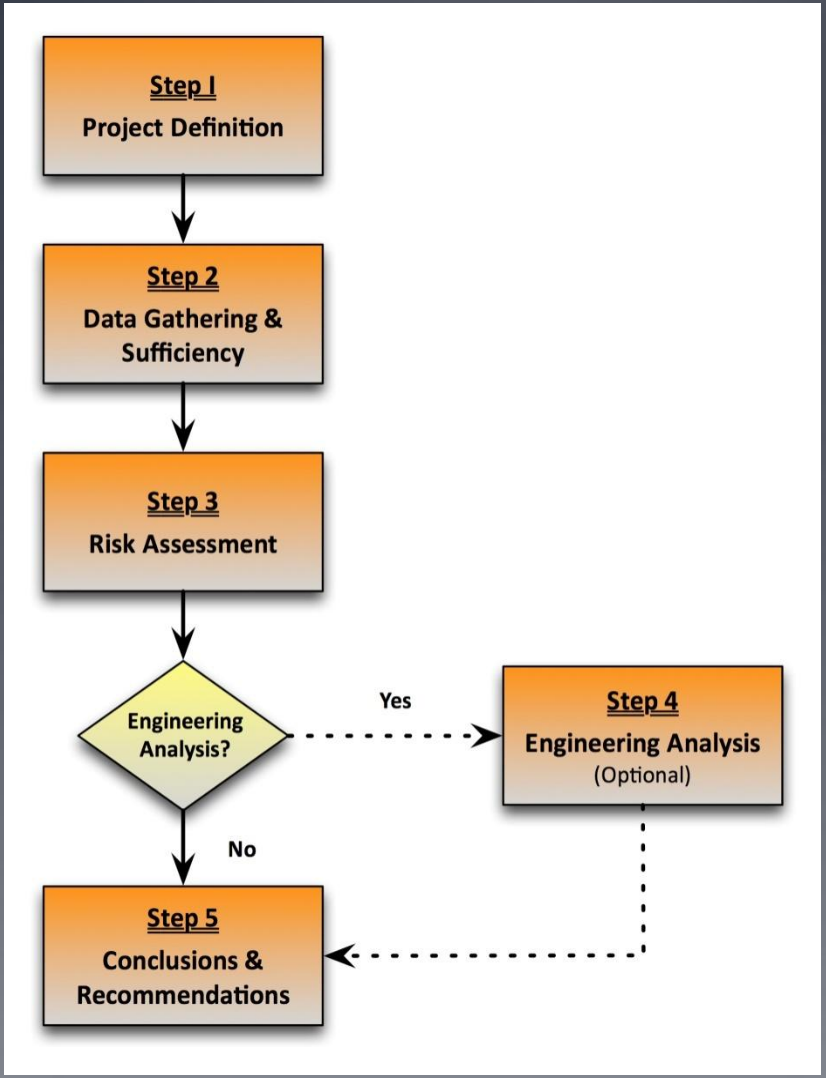
- Engineers Canada
- NRCan
- Transport Canada
- Environment Canada
- Infrastructure Canada
- Public Works and Government Services Canada
- National Research Council
- Alberta Infrastructure and Transportation
- NWT Department of Public Works and Services
- Government of Newfoundland and Labrador
- Institute of Catastrophic Loss Reduction
- Canadian Standards Association
- Federation of Canadian Municipalities
- Municipality of Portage la Prairie
- City of Toronto
- City of Delta, BC
- City of Calgary
- Ontario Ministry of Energy and Infrastructure
- Ouranos

PIEVC Engineering Protocol

- Five step evaluation process
- A tool derived from standard risk management methodologies
- Intended for use by qualified engineering professionals working with climate scientists, other disciplines (e.g. hydrologists geologists), managers, operators and maintenance staff
- Requires contributions from those with pertinent local knowledge and experience
- Focused on the principles of vulnerability and resiliency



A Structured Methodical Five Step Documented Process

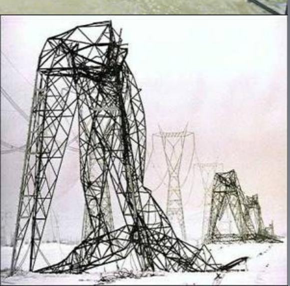





PIEVC Engineering Protocol Users (People!)

- Professional engineers (first audience)
- Municipal staff - Planners, managers, operators, maintainers
- Infrastructure asset managers
- Government policy-makers and regulators
- Infrastructure codes , standards and related instruments reviews and development
- Infrastructure owners and decision-makers
- Environment and economic analysts



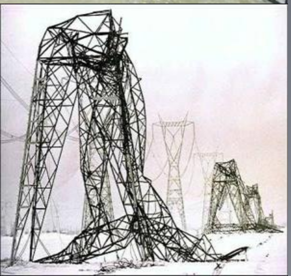
PIEVC Applications in Canada (Case Study Approach)

- Town of Shelburne, NS – New sewage treatment plant
- City of Laval – Stormwater treatment and management system
- City of Calgary AB – Potable water supply system
- Infrastructure Ontario – Three public buildings
- City of Toronto, ON – Three road culverts
- University of Saskatchewan - Engineering Building retrofit and addition
- Town of Welland, ON –Stormwater/wastewater management system
- 23 case studies completed – several more in progress

PIEVC Training Workshops

- Eighteen (18) training workshops delivered across Canada in past 18 months to over 750 people – several more scheduled in 2012
- Five (5) workshops delivered internationally (Brazil, Costa Rica, Honduras, Panama)
- Willing to deliver training workshops internationally on a cost recovery basis through WFEO
- Focus on knowledge development and capacity building
- Learn by doing !

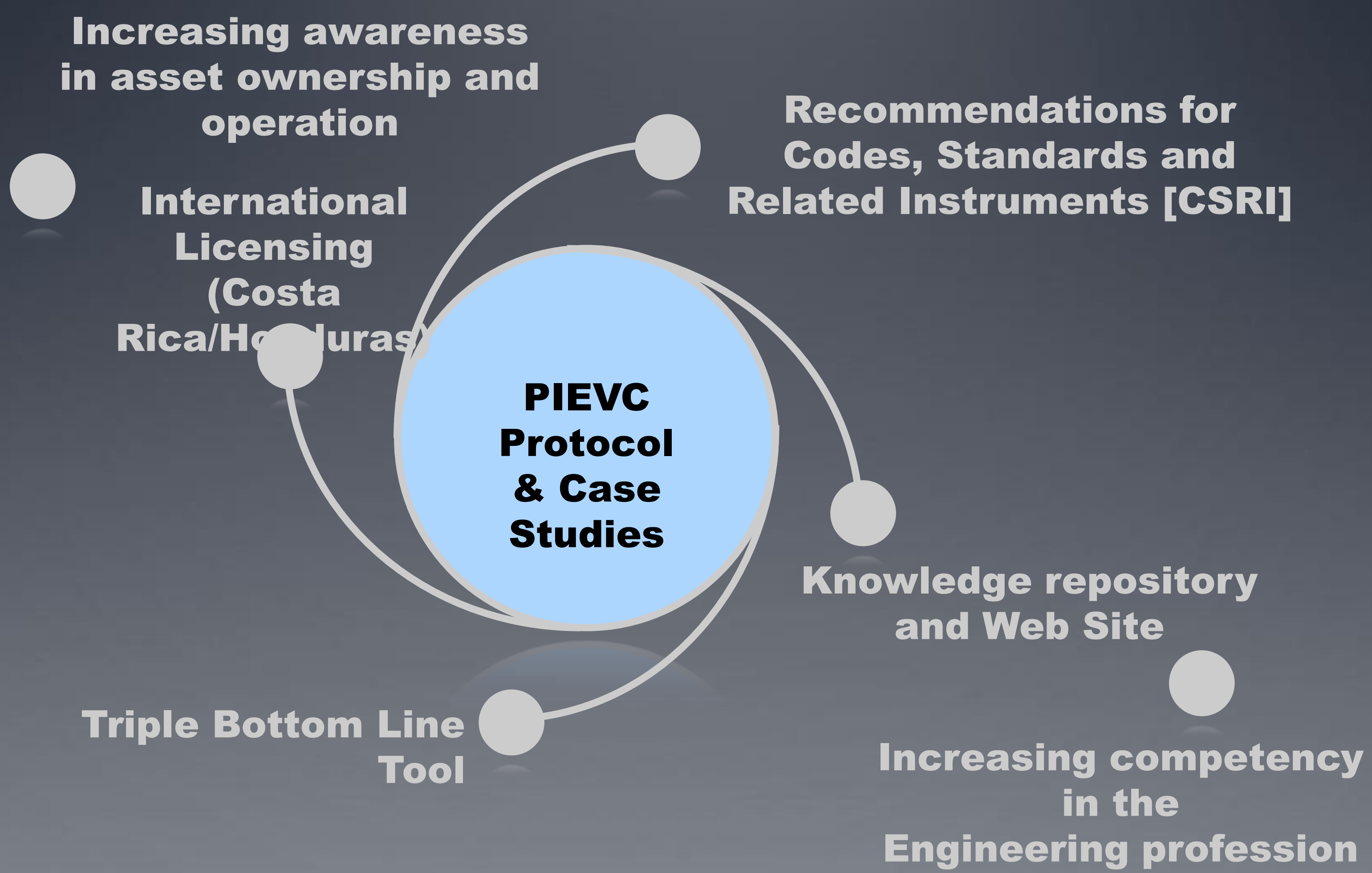


Benefits of Infrastructure Climate Risk Assessment

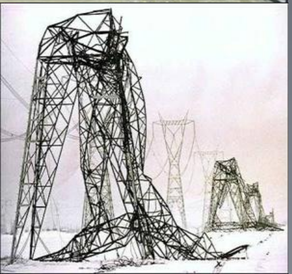
- Identify nature and severity of climate risks to infrastructure components
- Optimize more detailed engineering analysis
- Quick identification of most obvious vulnerabilities
- Structured, documented approach ensures consistency and accountability – **due diligence**
- Adjustments to design, operations and maintenance
- Application to new designs, retrofitting, rehabilitation and operations and maintenance
- Reviews and adjustments of codes, standards and engineering practices (underway in Canada)

Adaptive Management of the PIEVC Protocol



Questions



For more information on the PIEVC Engineering Protocol and International applications:

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