Transportation Resilience:

Opportunities for Regional and Cross-Sector Collaboration

Steve Winkelman | **May 11, 2017**

Adaptation Practitioners workshop: Collaborating for Regional Resilience
Ontario Climate Symposium 2017 Side event. York University, Toronto, Ontario

green resilience strategies

Photo: Xinhua /Landov / Barcroft Media
http://www.telegraph.co.uk/news/worldnews/northamerica/usa/9644856/Hurricane-Sandy-live.html

Outline: Transportation Resilience

- Introduction
- Cross-sector interdependencies
- Examples of transportation resilience solutions
- Regional collaboration
- Funding resilience
- Closing thoughts
- New resources
- Discussion Questions

Ottawa / Gatineau this week

J.D. Comtois, CBC, Chaudière Bridge

Central Québec this week

Tyler Ward, CTV, Mille Isles, QC

Montréal this week

CTV: Bridge to Ile Mercier off Ile Bizard

Montréal this week

CBC:Galipeault Bridge next to Île-Perrot

Montréal this week

Toronto Sun

Montréal this week

@JustinTrudeau

Overview: Transportation Resilience

- **Resilience** is the capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks.

  - Dave MacLeod, City of Toronto **[original source?]**

- Or,

  If it's all working
  we can just go about our business.

Transportation Resilience: Mechanical & Operational Solutions

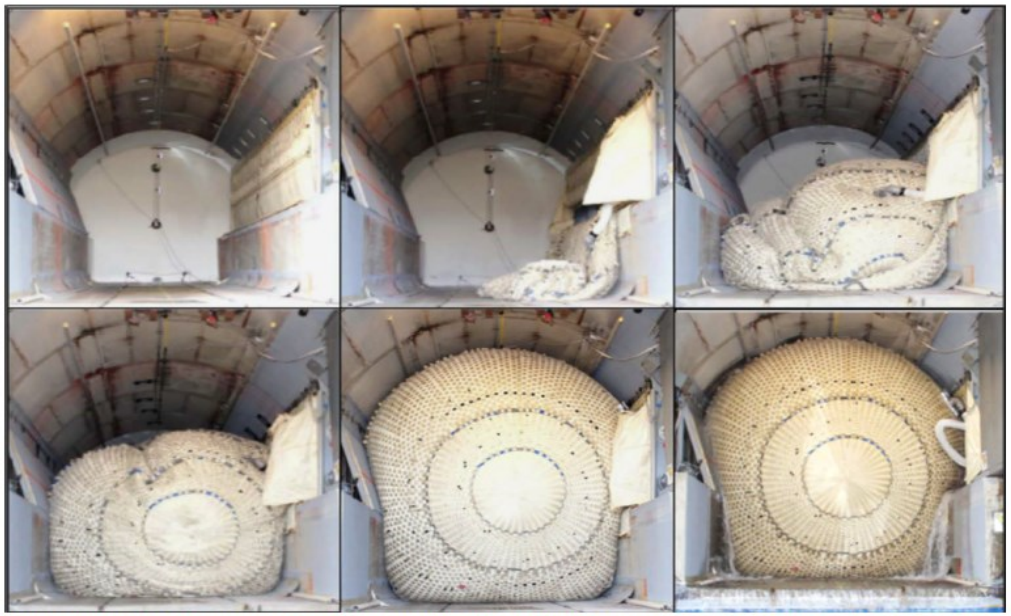
NYC subway flooding after a 2007 storm.
Source: MTA NYC Transit

Partial Solution
MTA NYC Transit has allocated nearly $90 million toward raising ventilation grates and installing stair pads at subway entrances.
Source: MTA NYC Transit

Transportation Resilience: Deployable Solutions

Portable barriers (ACSE)

Inflatable tunnel plug (NYC)



2015 TRB International Conference on Transportation System Resilience

Transportation Resilience: Design and operational improvements

A 2005 storm in **Toronto** caused $647 million in damages, including destruction of this culvert (left, $4 milliion) in losses, which was replaced with a larger, more resilient culvert (right). Source: Toronto Environment Office.

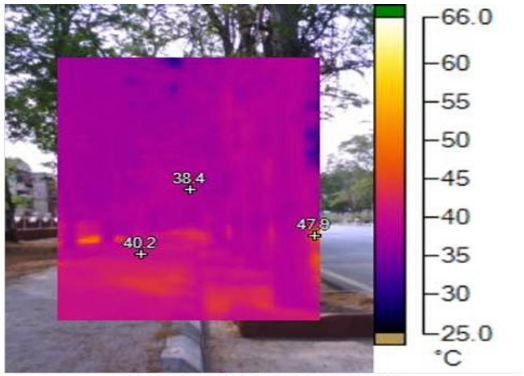
Photo credit for damaged culvert: Jane-finch.com.

Photo credit for new culvert: City of Toronto Transportation Services.

Transportation Resilience:
Network efficiency and redundancies

Torontoist

Transportation Resilience: Green Infrastructure



Thermal Infrared Image
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Visible Light Image
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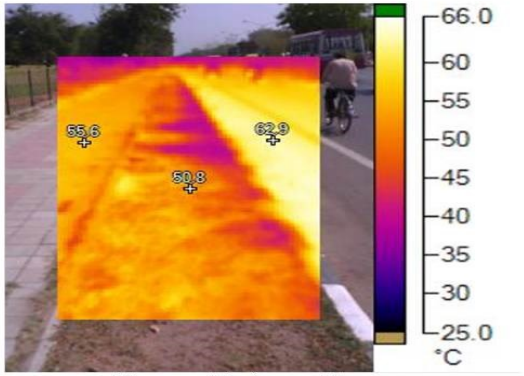

Thermal Infrared Image
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Visible Light Image
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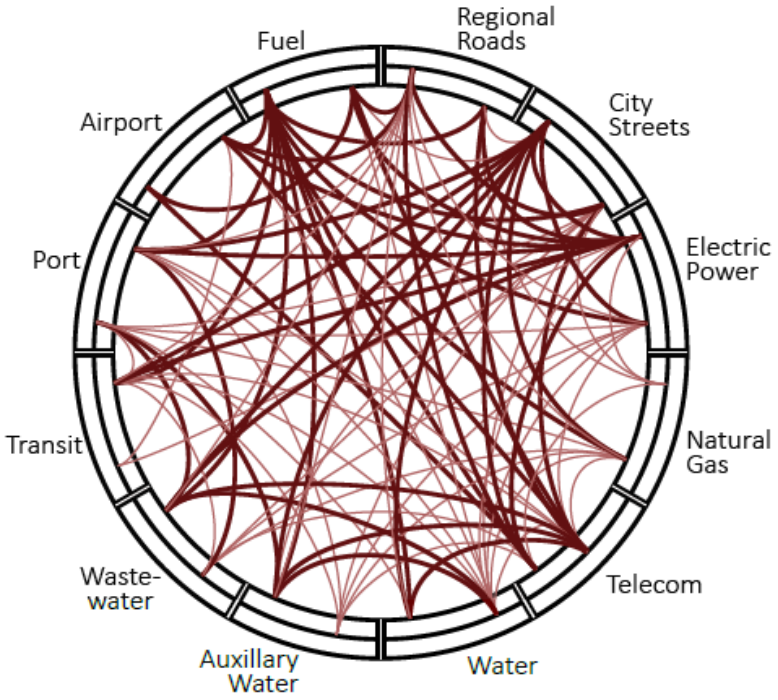
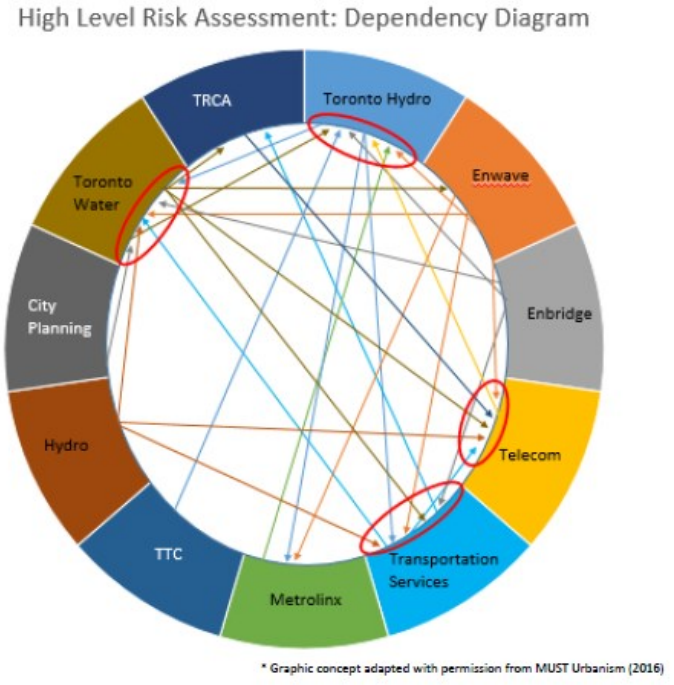
Cross-sector interactions

- Transportation systems are highly dependent on other infrastructure systems working



Source: San Francisco 2014

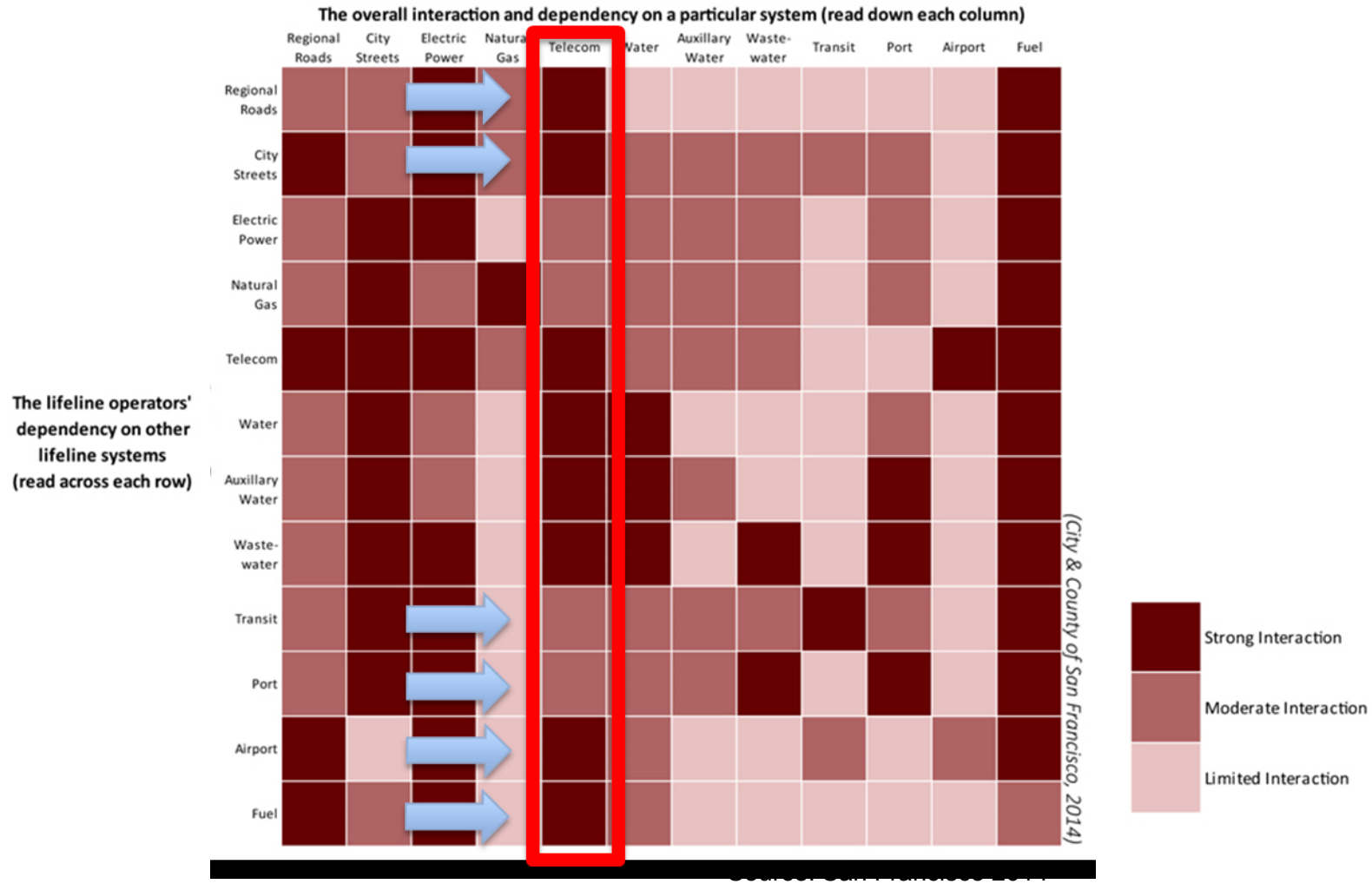


Source: David MacLeod, City of Toronto

Transportation is telecom dependent …

Source: European Telecommunications Standards Institute

… and Telecom is transportation dependent



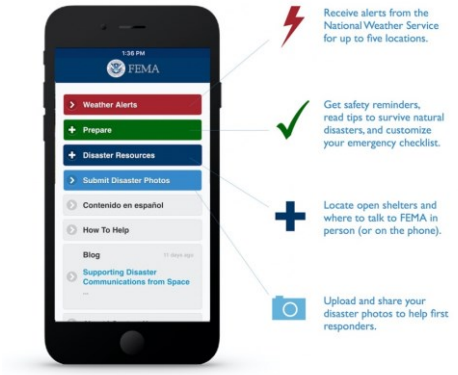
Transport information & control systems: Vulnerable to climate impacts

- **Direct & indirect infrastructure damage**
  - Flooding
  - Wind damage
  - Heat

Photo: www.shutterstock.com /Cheryl A. Meyer

- **Power outages → signal outages**

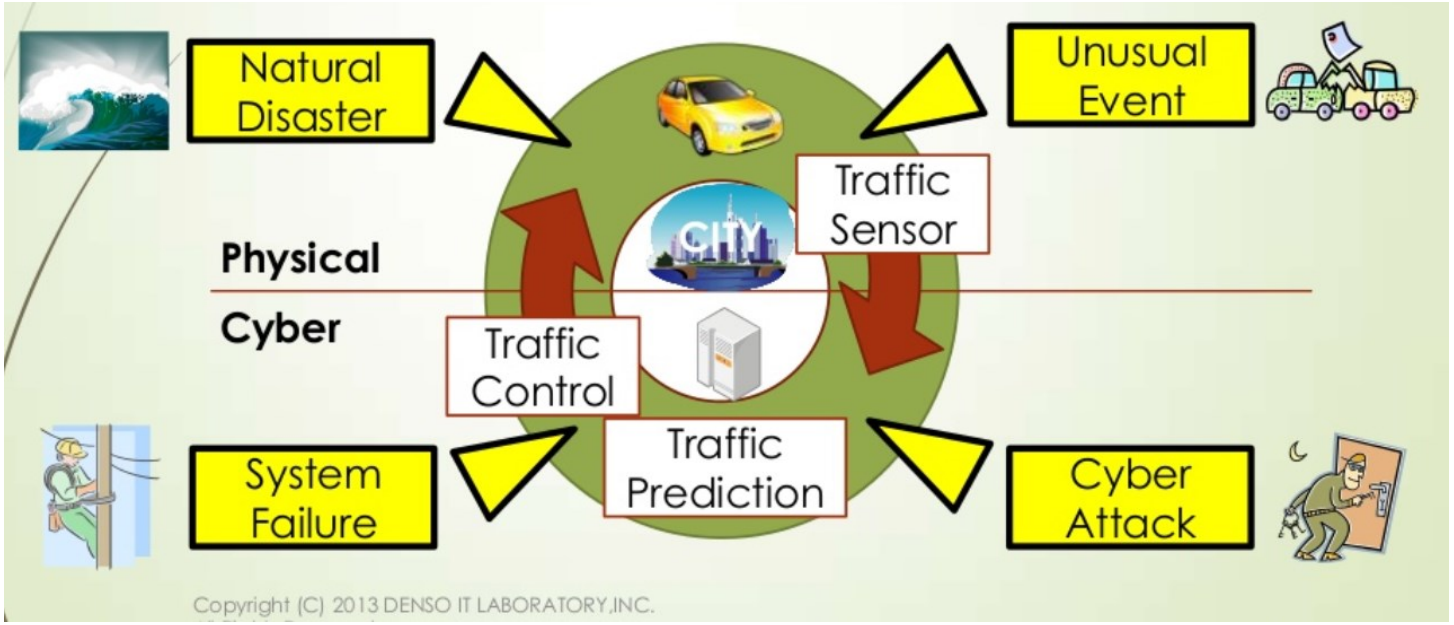
- **Increased demand for information services during extreme events**



Source: FEMA

Resilient Transportation should:

- Protect transportation infrastructure itself
- Protect transportation telecom infrastructure
- Protect infrastructure that transportation telecom depends upon
- Plan & design transportation systems to function during telecom outages



Source: Denso IT 2013

Regional Collaboration: on Resilience

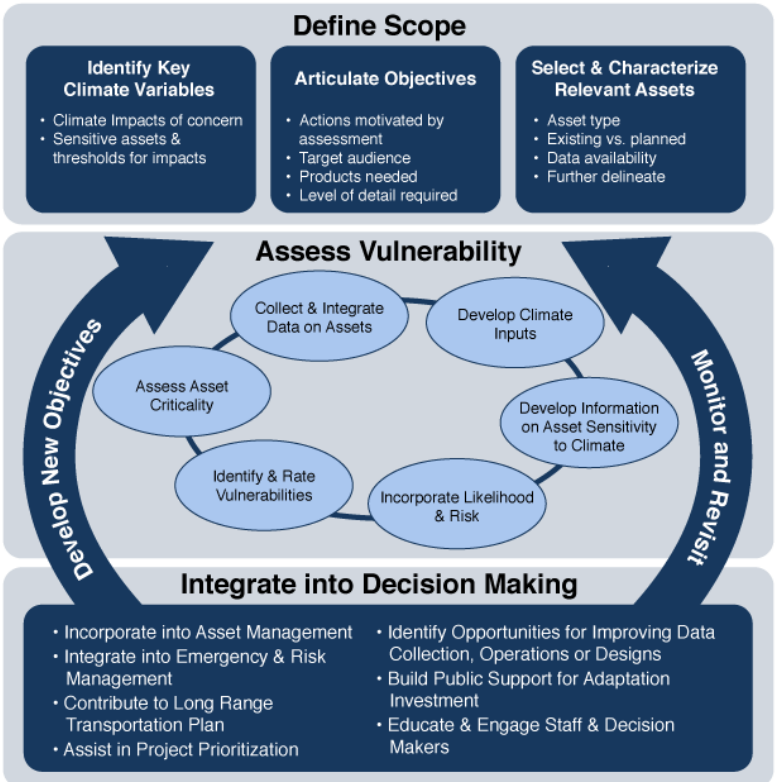
- Infrastructure systems cross municipal boundaries, so regional approaches to resilience make sense
- Organize around climate change, transportation, land use or hazard mitigation & leverage existing networks
  - **Southeast Florida Regional Climate Compact**
    - Modifying design standards for transportation infrastructure located in vulnerable areas
  - **Los Angeles Regional Collaborative for Climate Action**
    - Developing a model ordinance incorporating best adaptation practices and providing draft language for land-use plans, zoning, and other municipal policies

Regional Collaboration: Integrated Resilience Solutions

- **Sacramento Region Transportation Climate Adaptation Plan**
  - Planning, design & maintenance strategies for infrastructure
  - Incorporation of climate adaptation into transportation funding decisions, long-term transportation & land use plan, and monitoring
- **San Francisco region**
  - Conducting climate resilience studies on impacts to specific communities, coastlines and transportation assets.
- **St. Paul Minnesota**, Capitol Region Watershed District, Metropolitan Council : Greening the Greenline
  - 11 mile light rail system, 111 acre drainage area (highly developed)
  - Rain gardens, stormwater planters, infiltration trenches, 1,000 trees over 5 miles of tree trenches -- reduces runoff by more than 50%

Research and Technical Assistance on Transportation Resilience

- US FHWA Climate Change Resilience Efforts
  - Guidance on highways in river and coastal environments
  - Adaptation Framework
  - Pilots: 24 state, regional, local
  - Research:
    - Transportation Engineering
    - Green Infrastructure
    - Hurricane Sandy
    - Gulf Coast Study



FHWA climate adaptation pilots highlights of collaborative analysis

- CA: adaptation evaluation & prioritization tool
- CT : systems-level vulnerability assessment of bridges & culverts
- IA : methodology to integrate climate projections of rainfall within a river system model
- ME: depth-damage functions & adaptation design options
- MD : delineating “Climate Change Impact Zone” to help screen new project plans and designs
- MA: high-resolution flooding projections
- NY: environmental benefits multiplier for culverts

Funding Transportation Resilience

- There are a wide variety of financing, funding, and incentive tools
  - See ACT, Simon Fraser University: Paying for Urban Infrastructure Adaptation in Canada (2015)
- How can we leverage infrastructure funding?
- How can we leverage GHG mitigation funding (e.g., cap-and-trade revenues)?
- Consider "Green Resilience" solutions that mitigate GHGs and advance adaptation

Ask the Climate Question

Ask the Climate Question:

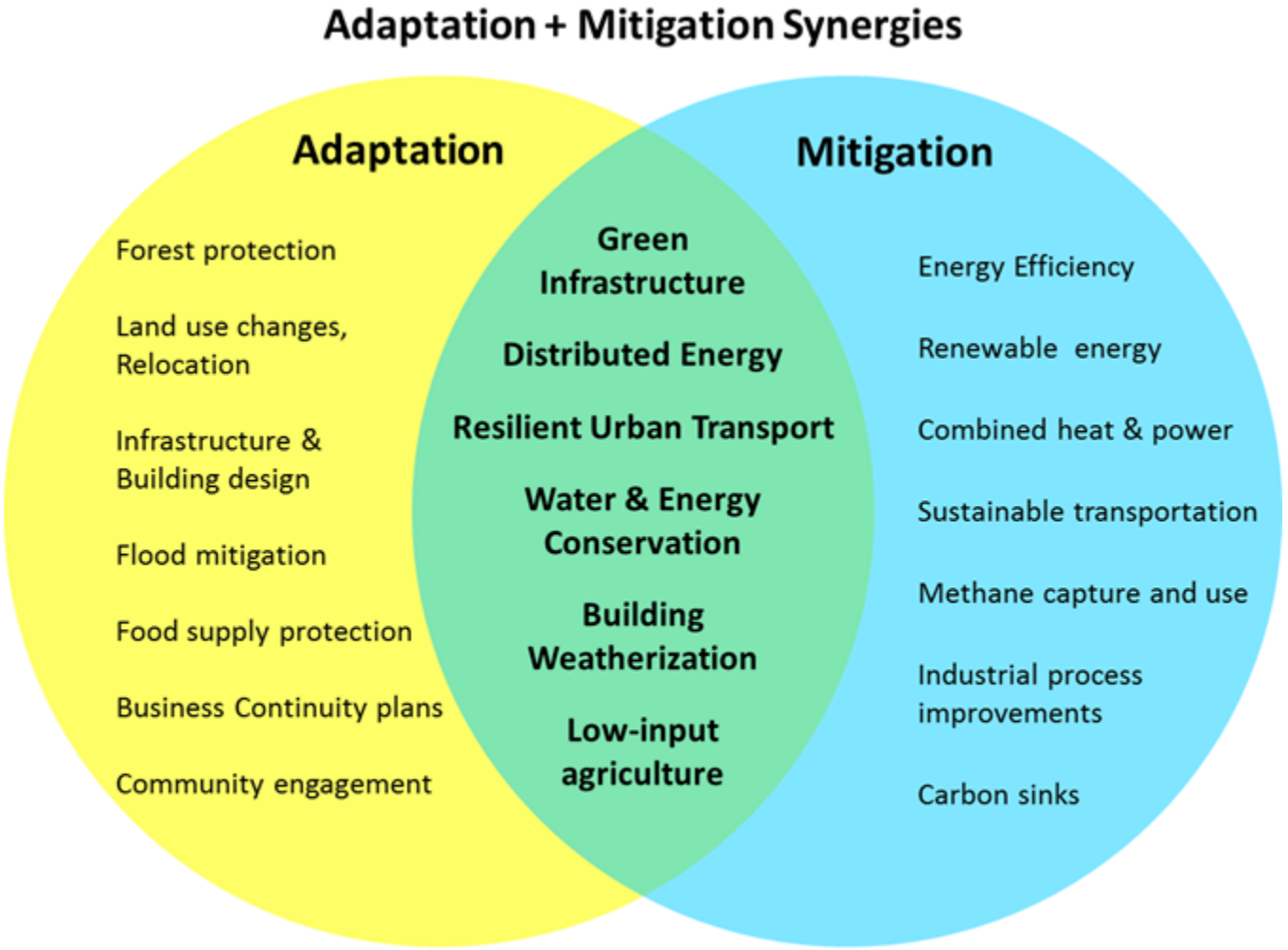
How will <u>policies</u> and <u>investments</u> affect GHGs & Climate Resilience?

↓ GHGs 🙂 or ↑ GHGs ☹ ??

↑ Resilience 🙂 or ↑ Vulnerability ☹ ??

Green Resilience

- **Increase return on investments**
- **Expand funding sources**



S. Winkelman 2016.
Graphic concept modified with acknowledgement of David MacLeod, City of Toronto.

Follow the Money:
Adaptation, Mitigation and Infrastructure

Green Resilience Matrix

Identifying Climate Adaptation + Mitigation Synergies

WHAT ARE YOUR TOP INVESTMENTS?

Ask the Climate Question		Adaptation	Mitigation	Infrastructure
				
Investments	#1	$10,000,000 Dune restoration	$10,000,000 Wind turbines & Photovoltaics	$2,000,000,000 Roads
	#2	$5,000,000 Green Infrastructure	$5,000,000 Green Buildings	$1,000,000,000 Water treatement facilities
	#3	$1,000,000 Vulnerability Assessment	$500,000 Education & Outreach	$500,000,000 Transit system improvements

$ MILLIONS

$ BILLIONS

Connect the Dots

A

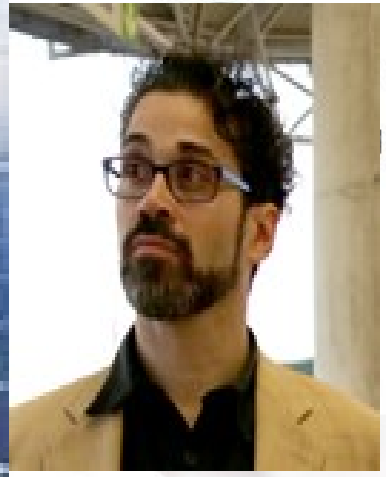
New building codes?

M

Energy & Water efficiency included?

M

Transit Oriented Development?



A+M

Resilient Green Building

Green Infrastructure?

A

A+M

Resilient & Sustainable Urban Development

A

M

Renewables?

Resilient Grid?

A+M

Resilient, Sustainable Energy

Hot off the presses:
Transportation Resilience

- Assessment of Climate Risks and Adaptation Practices for the Canadian Transportation Sector
  - Natural Resources Canada & Environment Canada
  - Release this week

- Infrastructure and Buildings Working Group, "State of Play Report"
  - Engineers Canada & Institute of Catastrophic Loss Reduction
  - Release this week

Discussion Questions

- Top vulnerabilities?
- Who needs to be involved?
- Interdependencies that need to be factored in?
- Regional rationale/benefit?
- Possible tools/actions to engage, identify and implement risk reduction?
- Technical assistance needs?
- Funding needs?

Thank you

Merci