# Costs and benefits of climate change impacts and adaptation in Canada: the economic case for action

**Richard Boyd, Director of Research, All One Sky Foundation**

ADAPTATION CANADA 2020 | 19-21st February 2020 | Vancouver, B.C.

CANADA IN A CHANGING CLIMATE

# NATIONAL ISSUES

- Cities and towns
- Remote and rural communities
- Water resources
- Ecosystem services
- **Costs and benefits of climate impacts and adaptation**
- Economic sector perspectives
- International dimensions
- Climate Disclosure, litigation and finance

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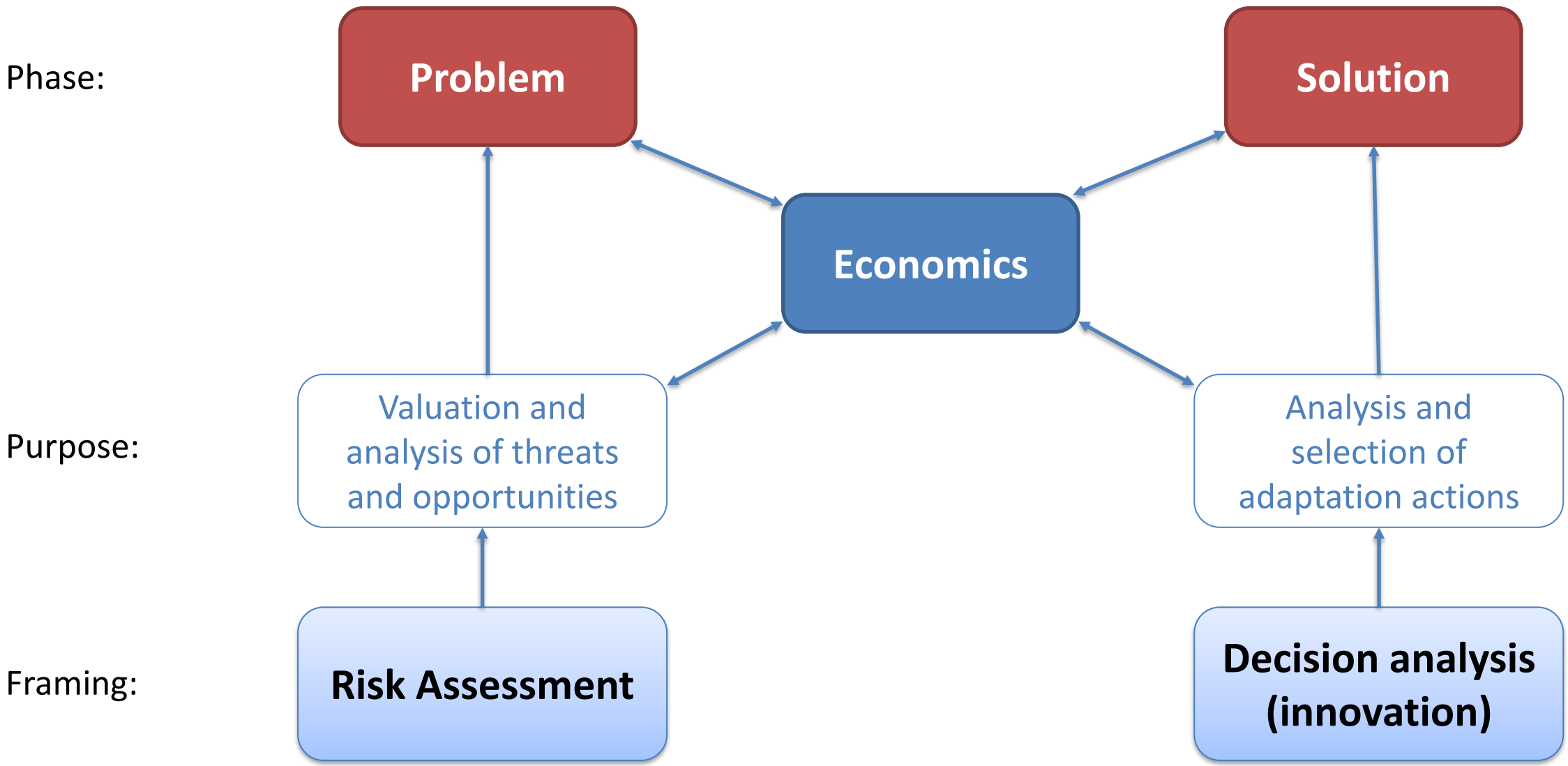
# Agenda

1. Context for economic analysis
2. Observed costs of extreme weather
3. Projected future costs of climate change
4. Evaluation of adaptation options
5. Economic limits to adaptation
6. Key messages

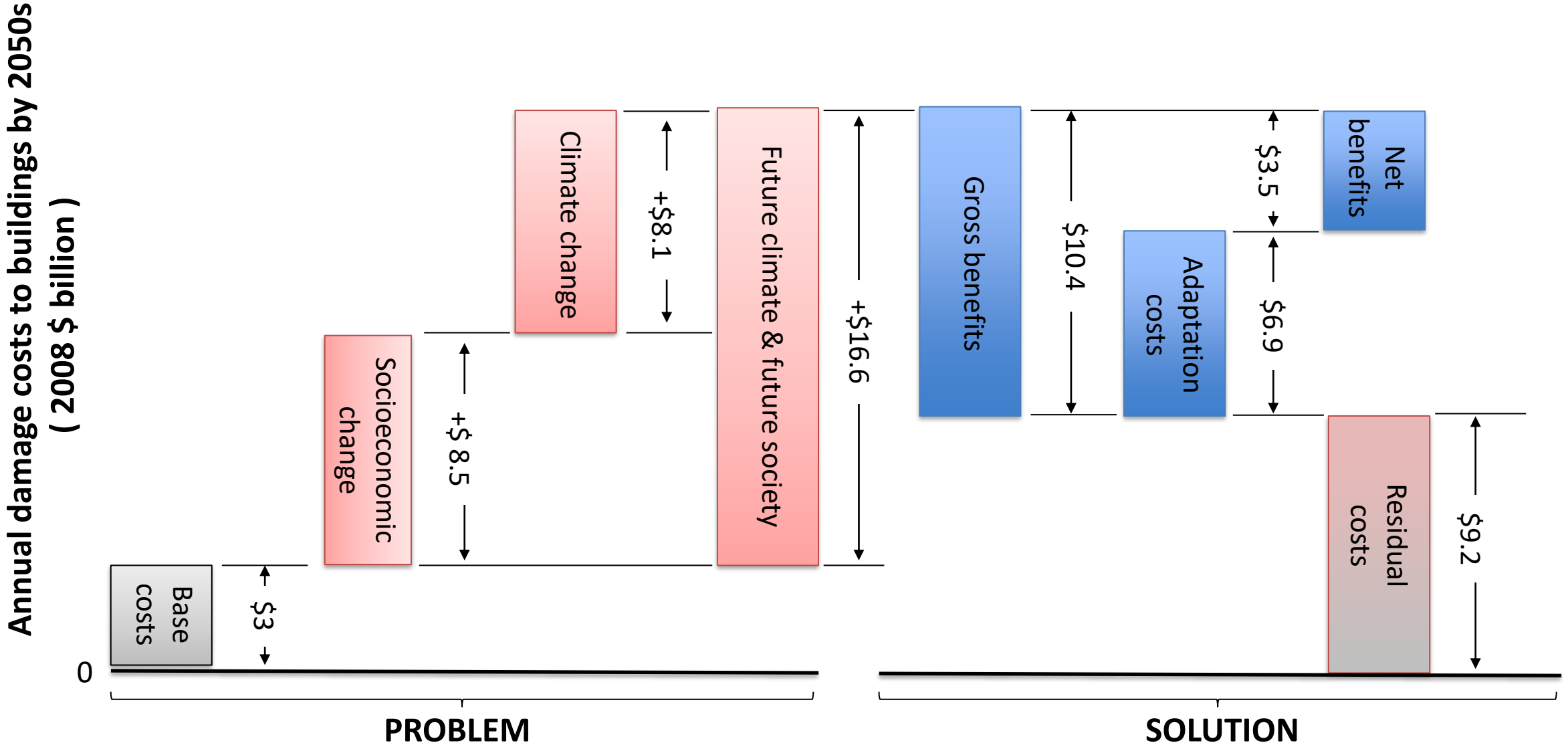
# 1. Context for economic analysis

# Role of economics in iterative climate risk management

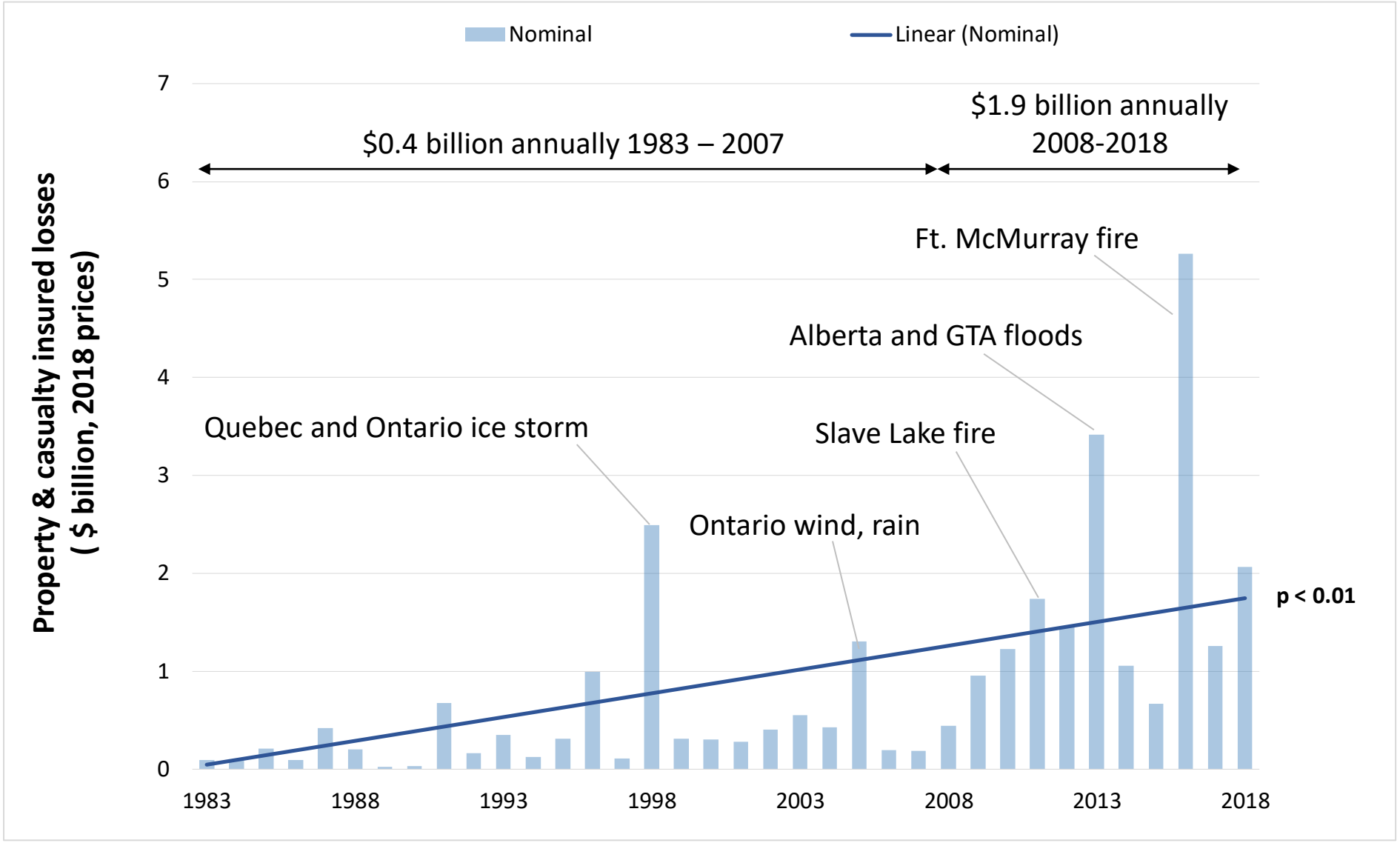



**Source:** Adapted from Jones et al (2013)

# Economics of adaptation



# Trends in damages from (catastrophic) extreme weather events



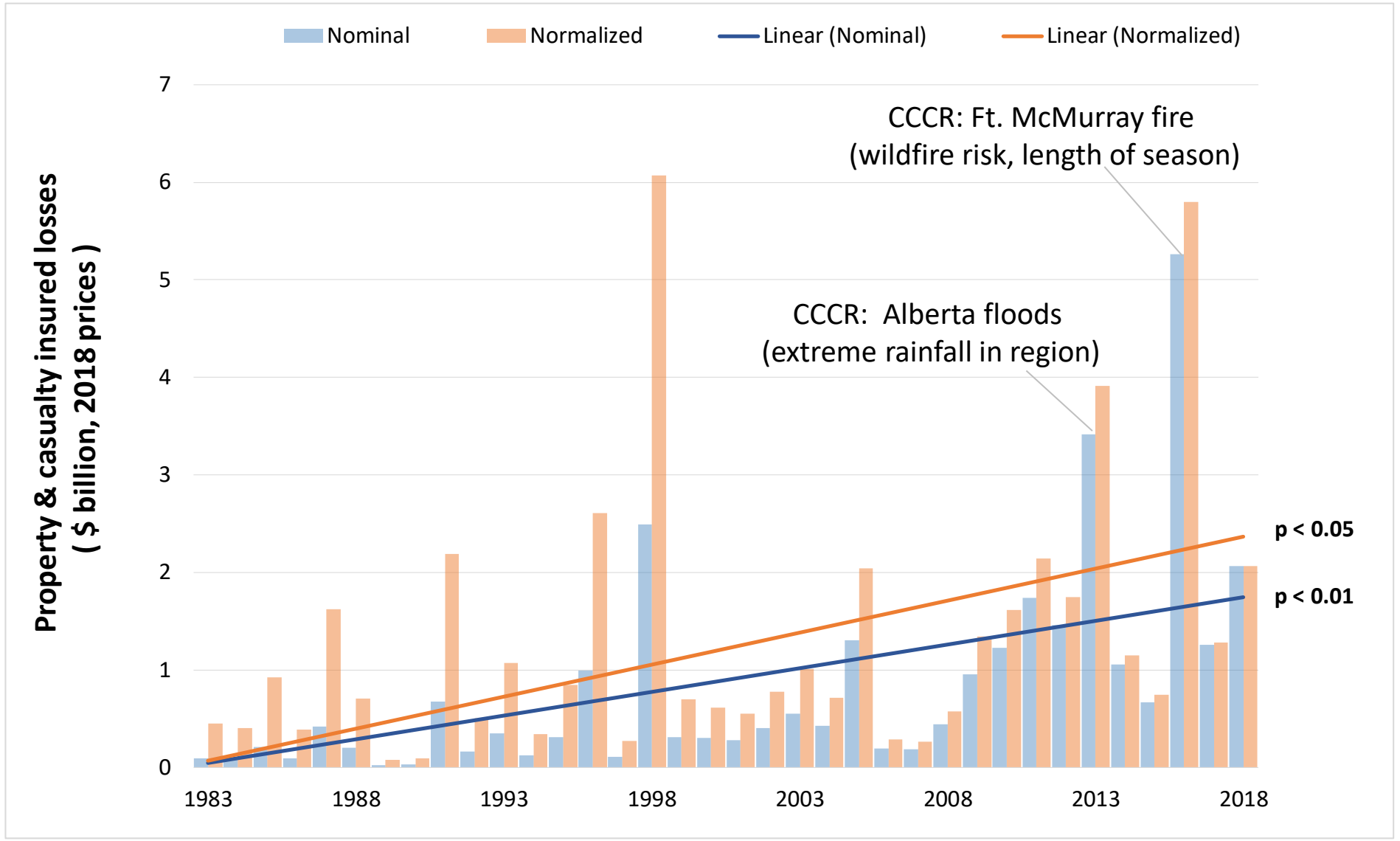

**Source**: IBC 2019 Facts

# “Alberta has become the place where bad weather pays a visit more often”

| DATE | PLACE | EVENT TYPE | LOSSES (current $ million) | LOSSES (2018 $ million) |
|---|---|---|---|---|
| 2016 | May 3–19, Fort McMurray AB | Fire | 3,750 | 3,900 |
| 1998 | Jan., southern Quebec | Ice storm | 1,380 | 2,020 |
| 2013 | June 19–24, southern Alberta | Flooding/Water | 1,600 | 1,740 |
| 2013 | July 8, Greater Toronto Area ON | Flooding/Lightning/Water | 920 | 1,000 |
| 2005 | Aug. 19, Ontario | Hail/Tornadoes/Wind | 630 | 780 |
| 2018 | May 4, Hamilton and GTA ON; Quebec | Windstorm/Water | 680 | 680 |
| 2011 | May 15–16, Slave Lake AB | Fire/Windstorm | 530 | 590 |
| 2014 | Aug. 7, central Alberta | Hail/Windstorm/Lightning/Water | 550 | 580 |
| 2012 | Aug. 12, Calgary AB | Hail/Lightning/Water | 520 | 570 |
| 2010 | July 12, Calgary AB | Hail/Flooding/Windstorm/Lightning | 490 | 560 |

**Source**: IBC 2019 Facts

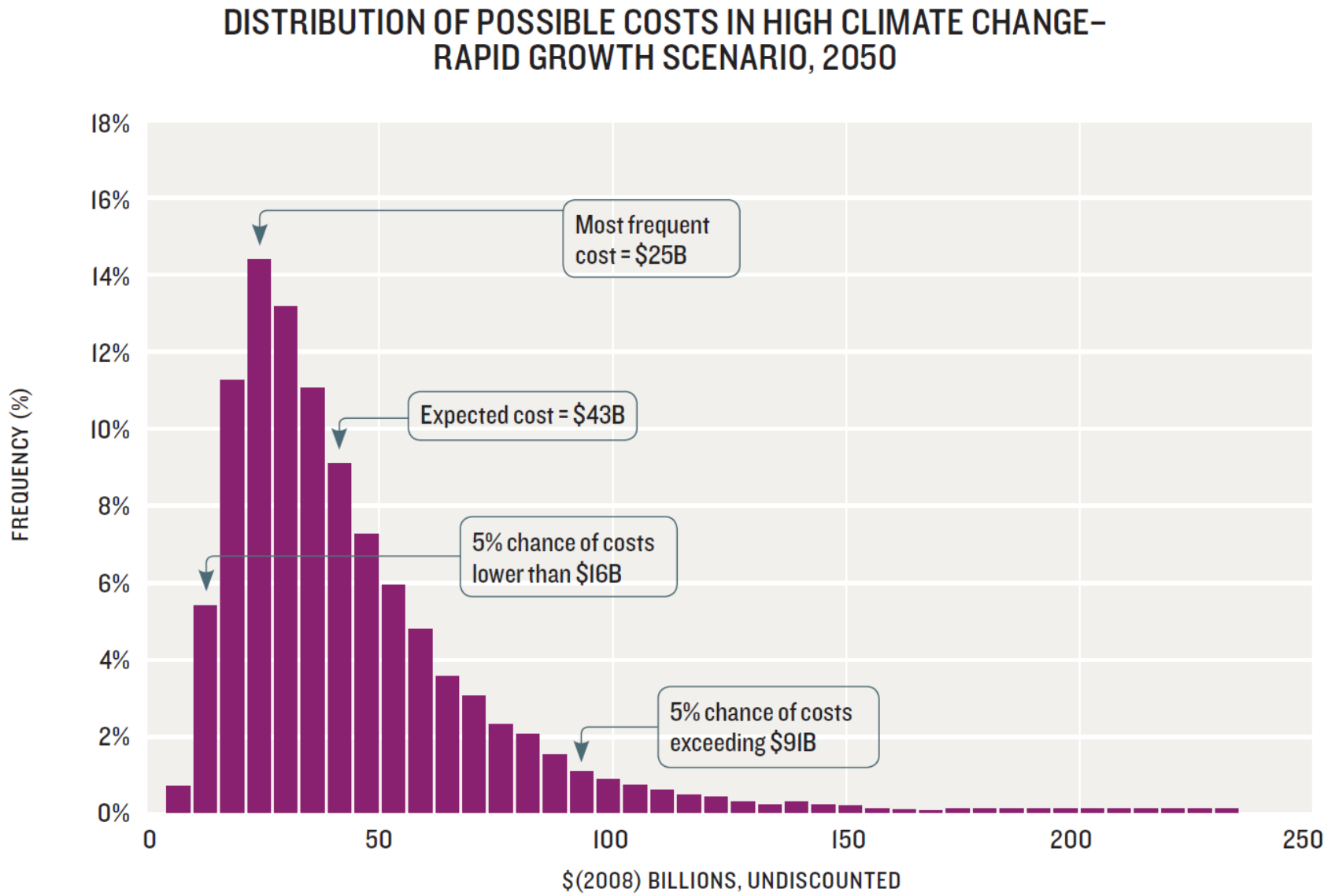
# Trends in damages from (catastrophic) extreme weather events




**Source**: Boyd and Markandya (forthcoming)

# 3. Projected economic consequences of climate change

# Projected future economic impacts of climate change - national




**Source:** NRTEE (2011)

# Projected future economic impacts of climate change – regions & sectors

## Coasts - national

$109-$379 Bn. PV costs

(2011-2100; DR = 3%; 2008 $)

Damages to dwellings from SLR and storm surge

## Forestry - national

$1,070 Bn. PV GDP costs

(2010-2080; DR = 3%; 2008 $)

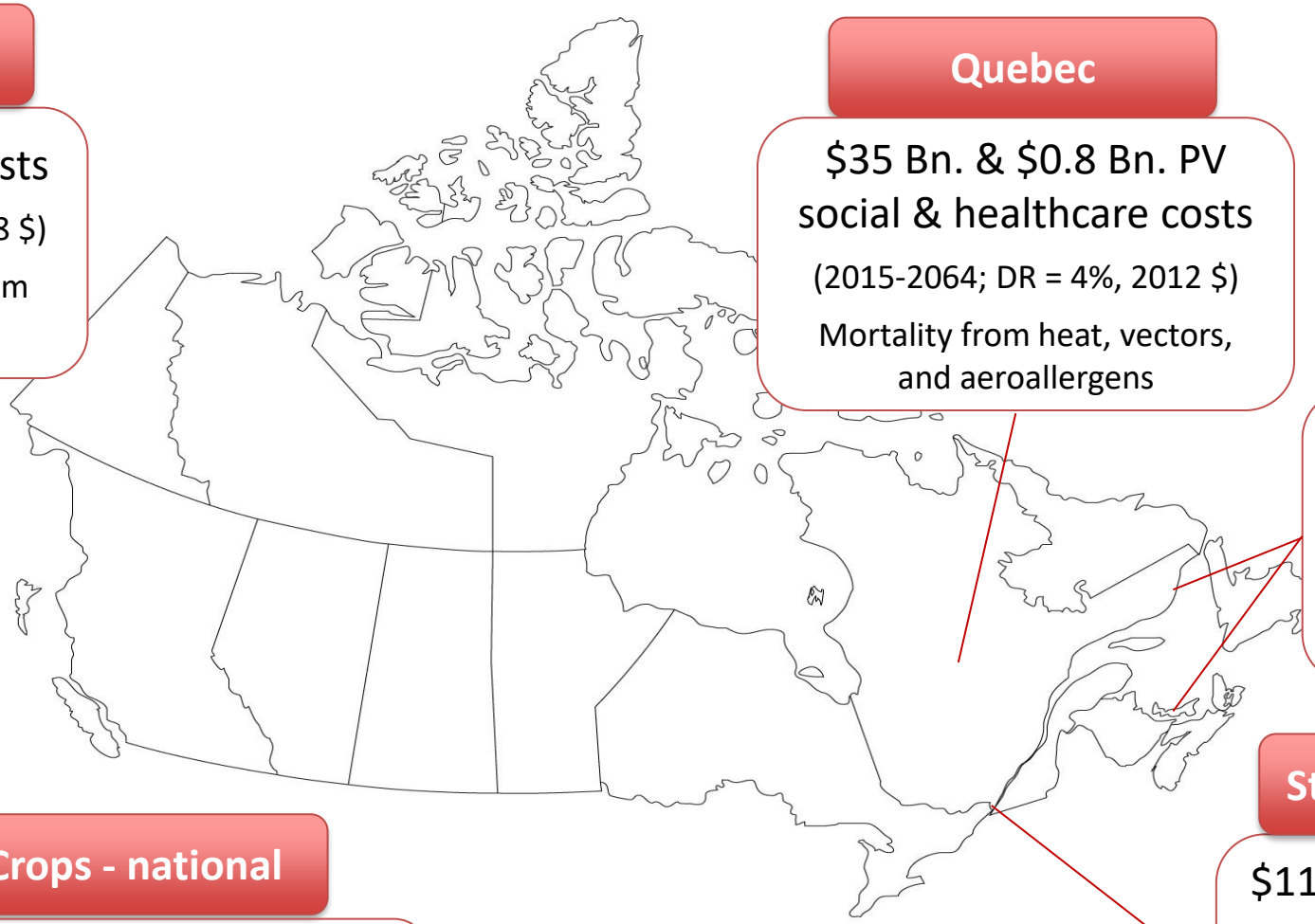
Impacts on timber supply from fire, pests and disease, and changes in productivity

## Crops - national

1.7% increase in PV of GDP

(2006-2051; DR = 4%)

Improvements in crop yields



## Quebec

$35 Bn. & $0.8 Bn. PV social & healthcare costs

(2015-2064; DR = 4%, 2012 $)

Mortality from heat, vectors, and aeroallergens

## Eastern coast

$1.2 Bn. PV costs

(2015-2064; DR = 4%; 2012 $)

Market & non-market damages from SLR, storm surge and erosion

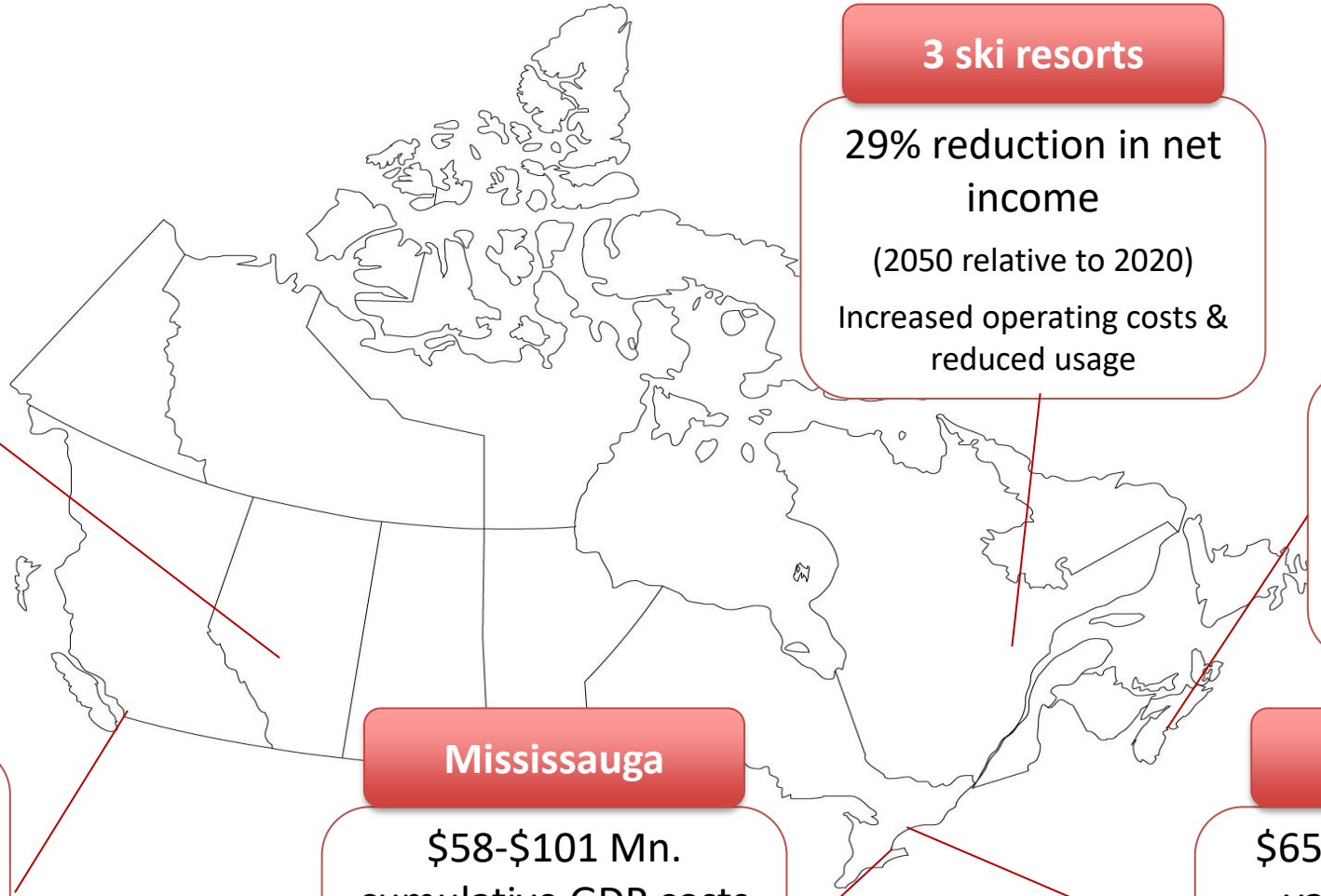
## St. Lawrence & lakes

$11.4-$11.7 Bn. PV costs

(2015-2064; DR = 4%; 2012 $)

Low flow impacts to hydro, recreation, waterfront property, shipping

# Projected future economic impacts of climate change - municipalities



## Edmonton

$10.5 Bn. social costs pa

(2080s relative to 1980s)

Damage to heath, built and natural environment from 17 climate hazards (2018 $)

## 3 ski resorts

29% reduction in net income

(2050 relative to 2020)

Increased operating costs & reduced usage

## Halifax

$90-$175 Mn. cumulative GDP costs

(2040 relative to 2015)

Damages from storm surge and high winds (2013 $)

## Vancouver

$36-$48 Bn. present value social costs

(2010-2100; DR = 4%; 2008 $)

Mortality from heat and poor air quality

## Mississauga

$58-$101 Mn. cumulative GDP costs

(2040 relative to 2015)

Damages from stormwater and freezing rain (2013 $)

## Toronto

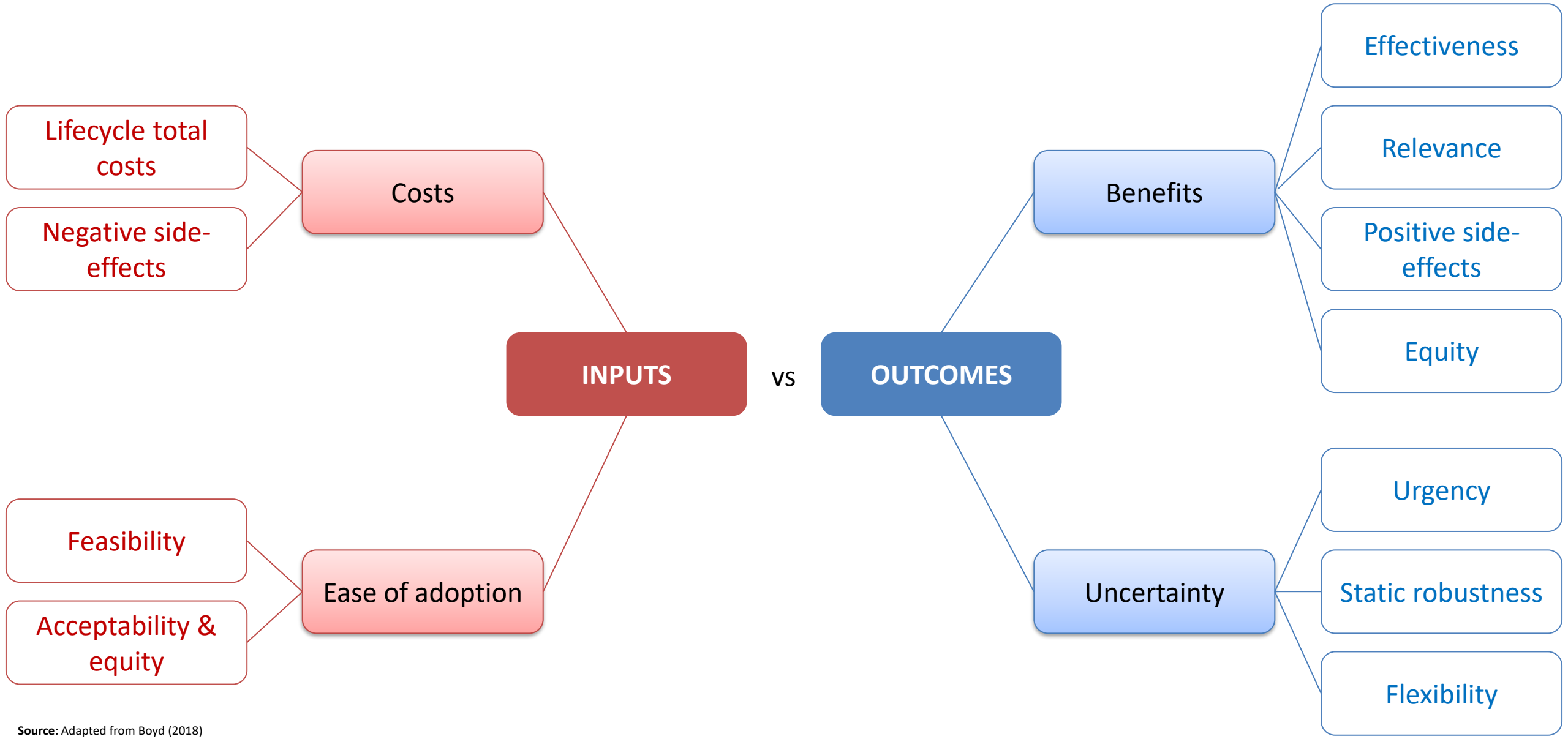
$65-$96 Bn. present value social costs

(2010-2100; DR = 4%; 2008 $)

Mortality from heat and poor air quality

# 4. Evaluation of adaptation options

# Analysing trade-offs to inform adaptation decisions




**Source:** Adapted from Boyd (2018)

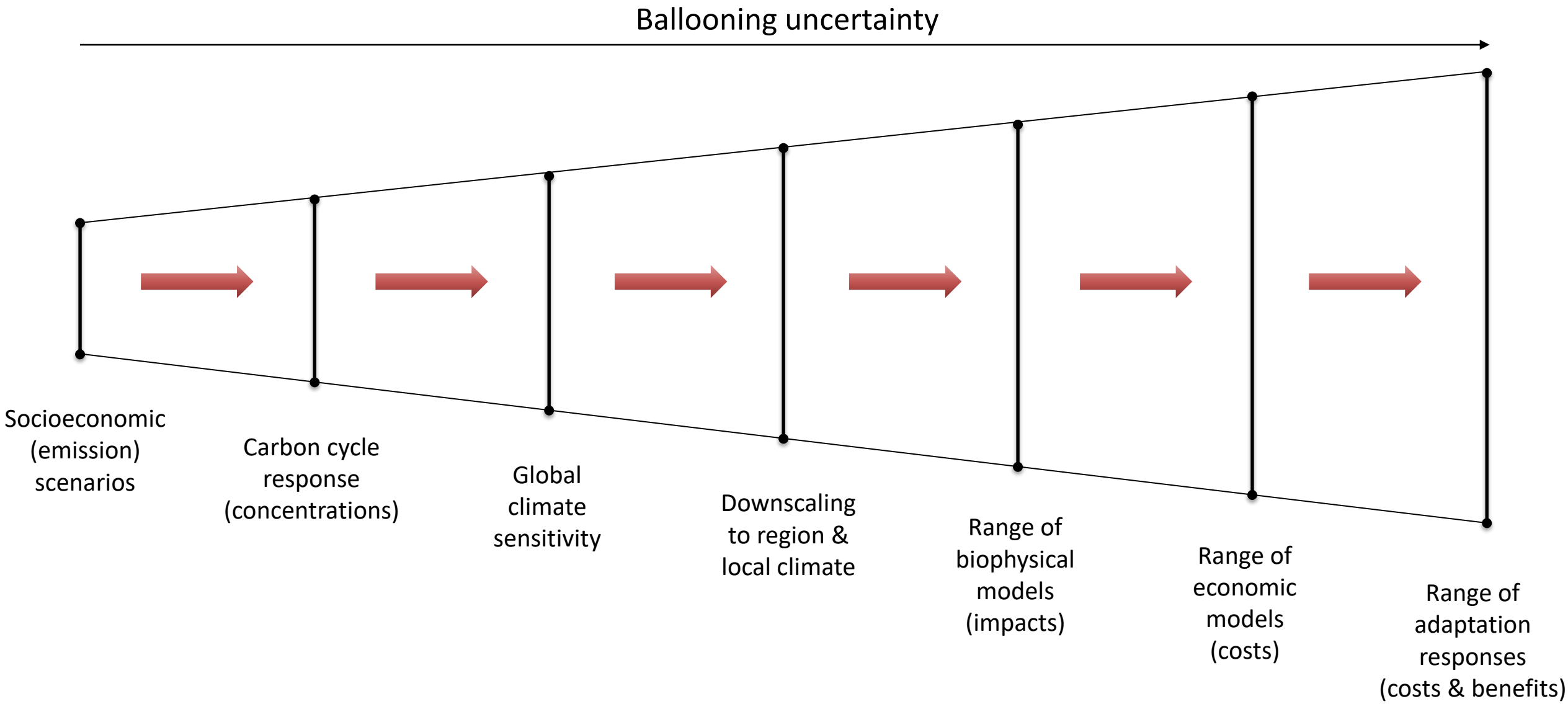
# Cost of adapting to climate change

- ✓ **0.26%** of GDP per year nationally (expenditures in municipal adaptation plans; FCM & IBC, 2019)

- ✓ **0.12%** - **0.25%** of GDP per year over next 5 years (expenditures on drinking water, sanitation, drainage, green infrastructure and roads in Quebec; Ouranos, 2019)

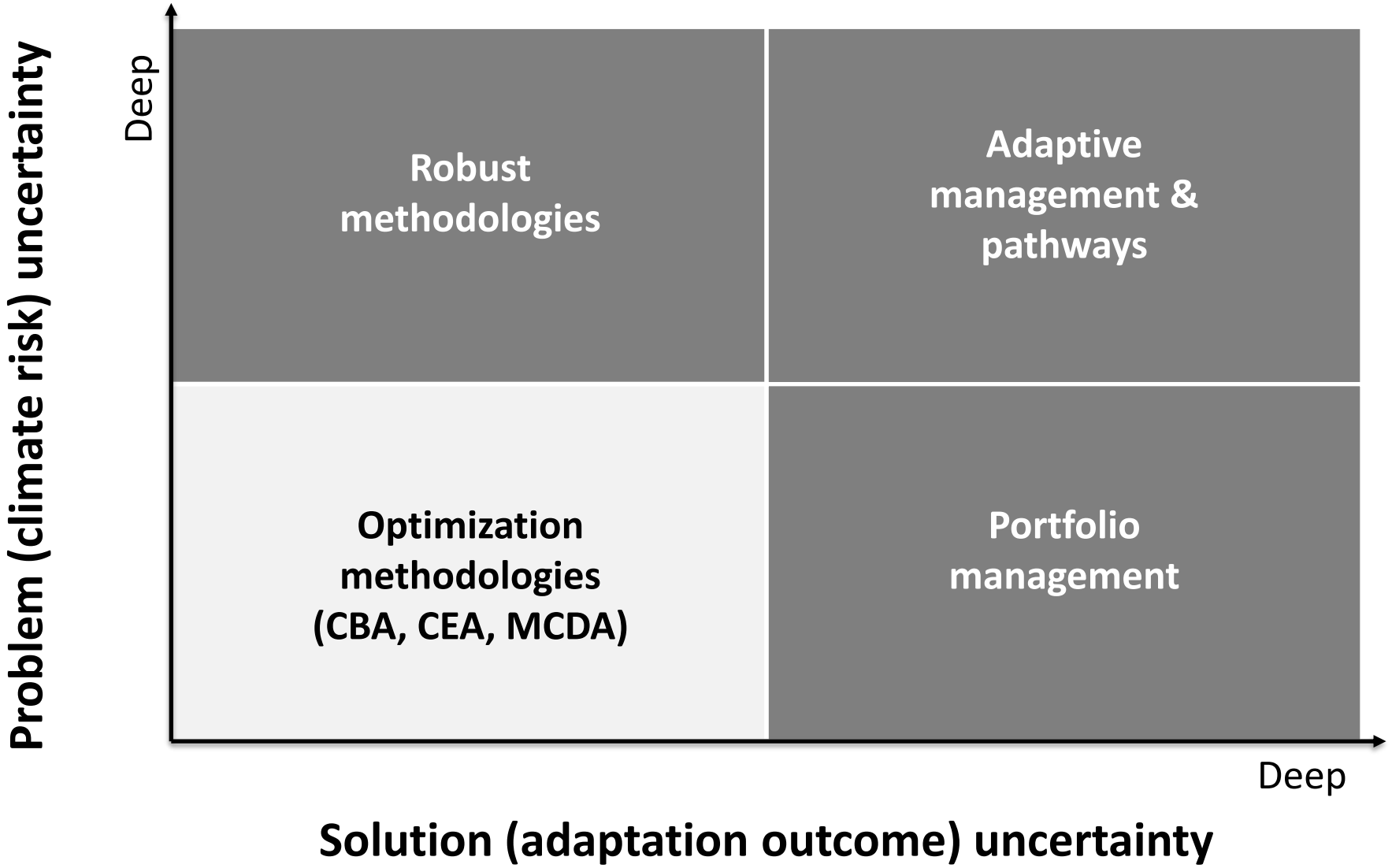
- ✓ **0.22%** – **0.23%** of GDP in 2014/15 (public and private sector spend on adaptation in NYC, London and Paris; Georgeson et al., 2016)

# Ballooning outcome uncertainties – reason for delaying action?



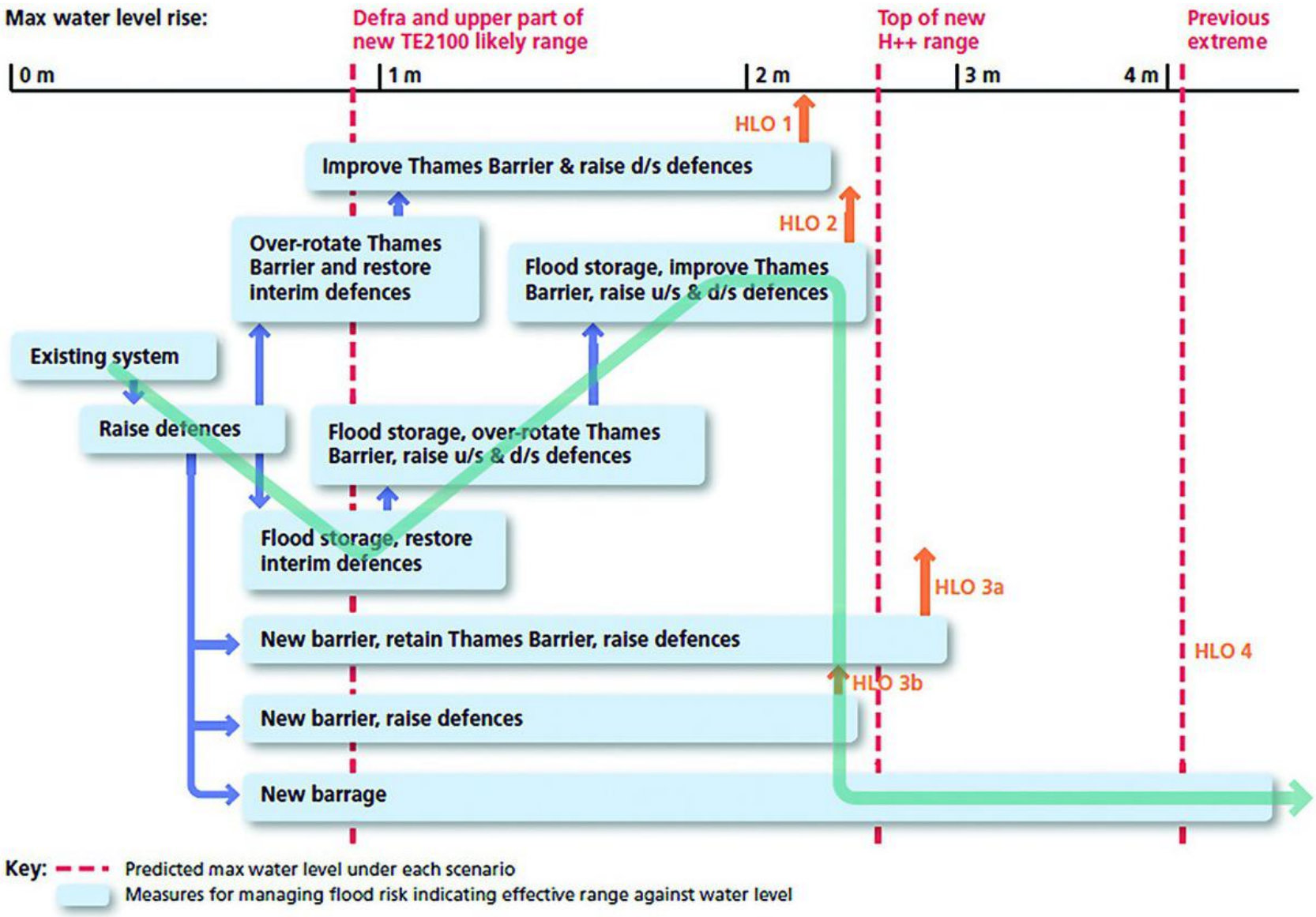

**Source:** Adapted from Boyd and Hunt (2004)

# Economic decision support tools under deep uncertainty

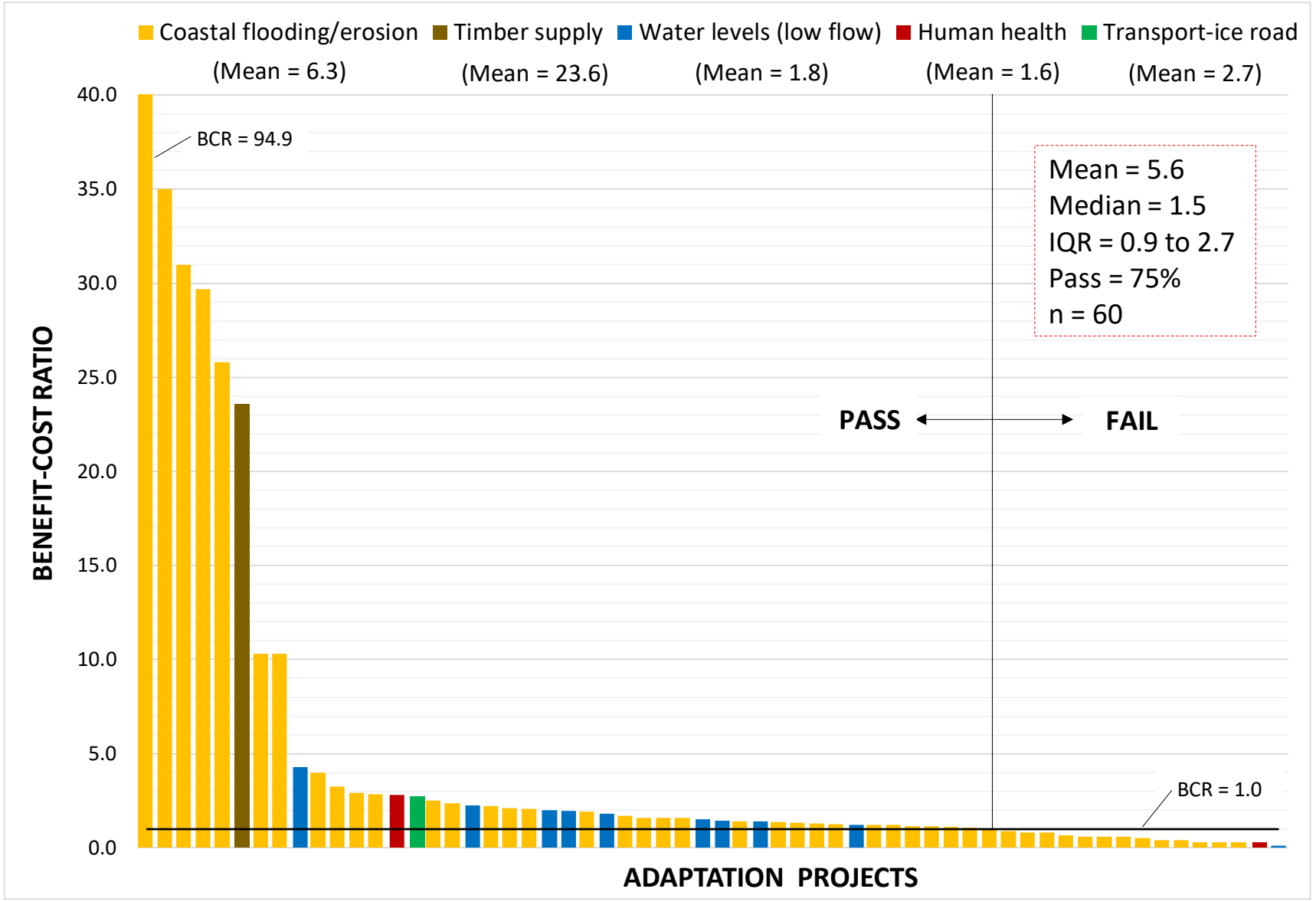



**Source:** Adapted from Jones et al (2013)

# Illustration of adaption pathways to manage uncertainties



# CBA of sample of adaptation options in Canada



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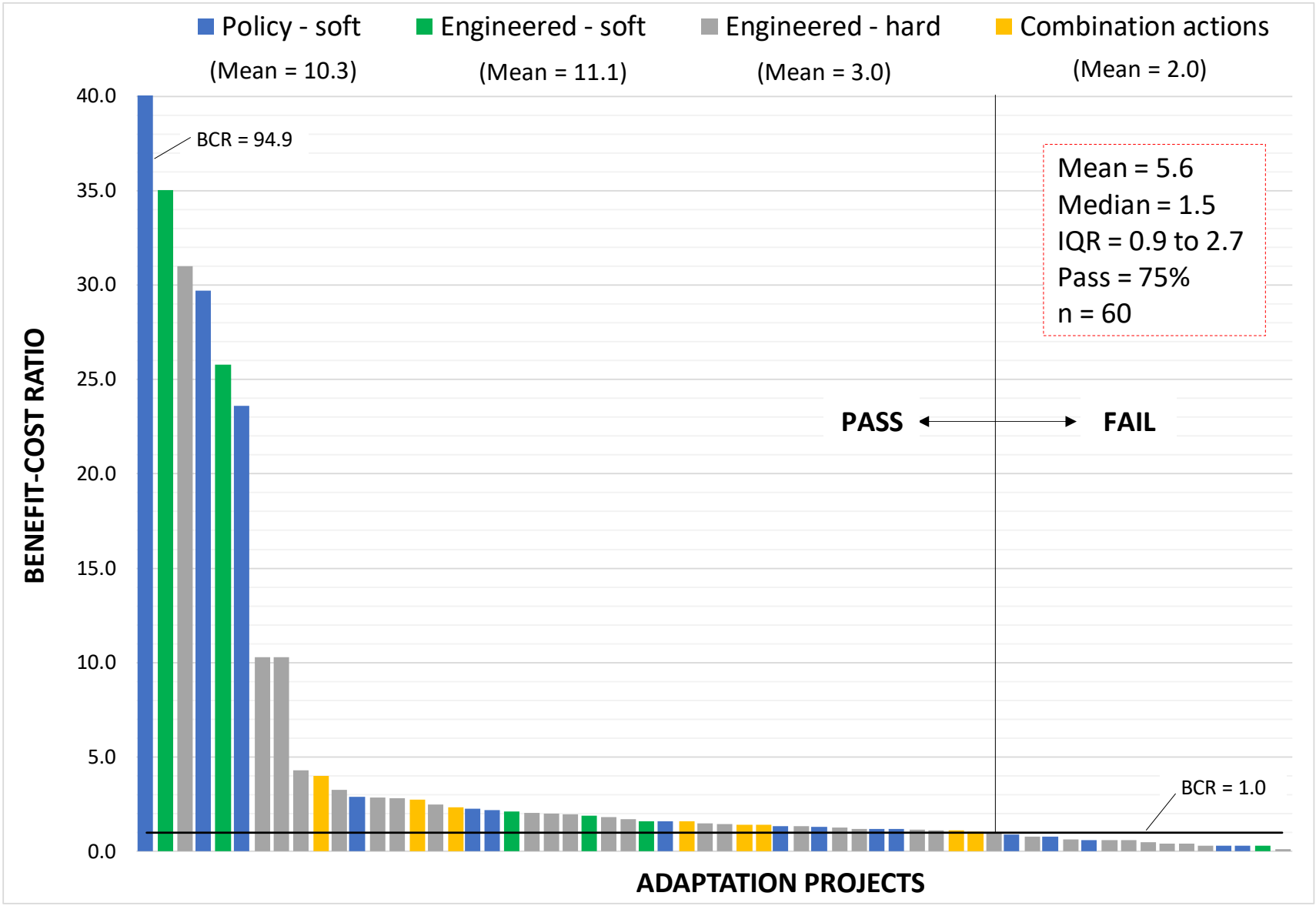


# 5. Economic barriers and limits to adaptation

# Economic barriers and limits to meeting all adaptation needs

Mitigate all risks

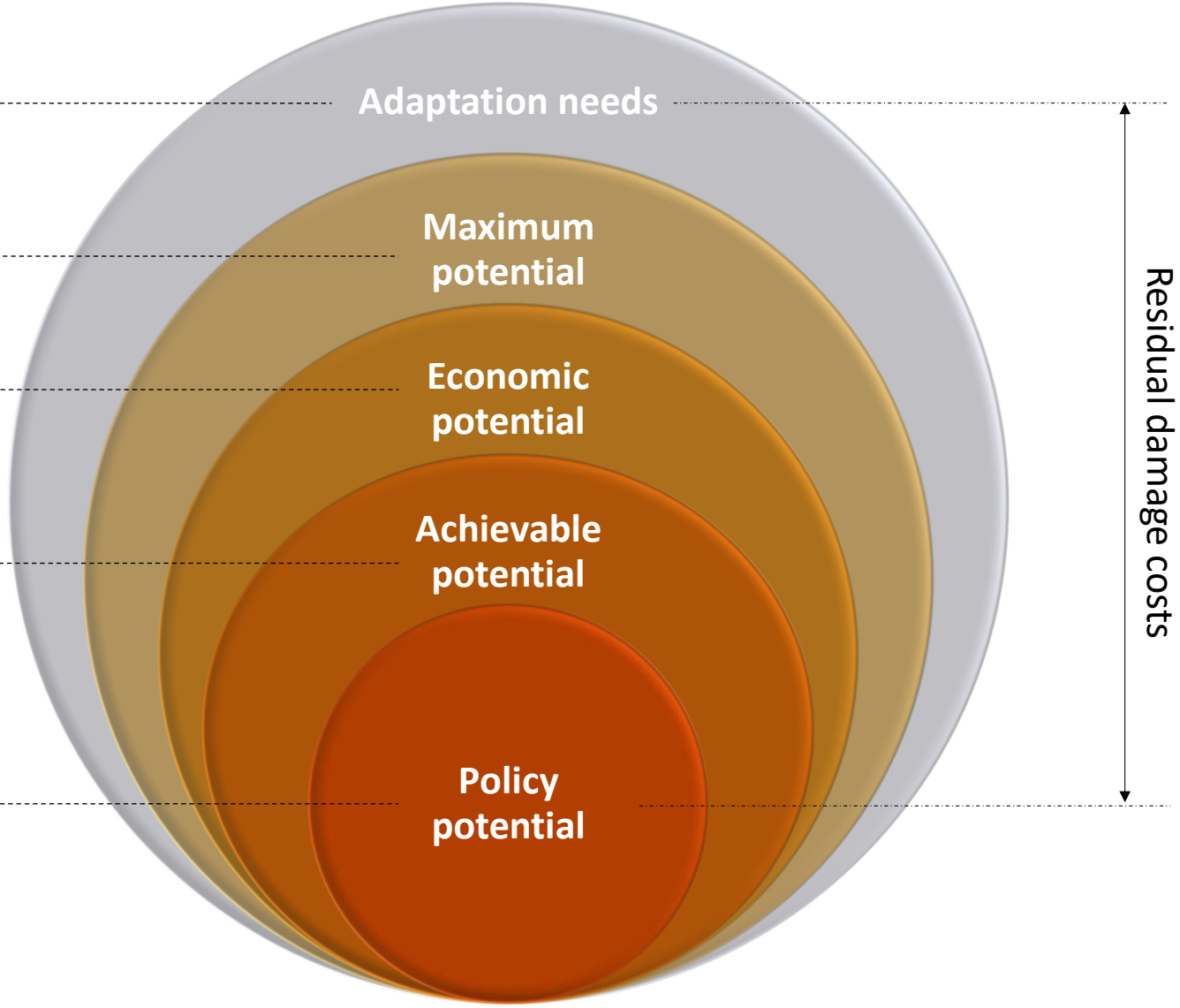
Technical and ecological limits

Adaptation benefits > costs

*Market, behaviour and policy failures*

Public intervention benefits > costs

Funding and capacity constraints



# 5. Key messages

# Key messages

1. Insured losses significant and rising (+$60 million per year)
2. Climate link? Adaptation deficit (potential for no-regret options)?
4. Significant projected future costs for regions, sensitive sectors (except crops) and cities
5. Many gaps in coverage
6. Much more to know about cost of adaptation
7. Strong economic case for adaptation, though returns variable and context specific
8. Uncertainty not reason for delay
9. Economic limits to adaptation, expect residual costs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