

# The Changing Geography of the Winter Olympics in a Warmer World



# 100 Years of 'Weather Proofing' the Winter Olympics



Hockey  
Moved  
Indoors



Snow Transport & Compaction



Refrigerated  
Bobsled-Luge Track



Snowmaking



Expanded Weather  
Forecasting Services



Snow Stockpiling



Salting Ski Courses



Refrigerated Ski Jumps

1924-Chamonix

1928-St. Moritz

1932-Lake Placid

1936-Garmisch

1948-St. Moritz

1952-Oslo

1956-Cortina

1960-Squaw Valley

1964-Innsbruck

1968-Grenoble

1972-Sapporo

1976-Innsbruck

1980-Lake Placid

1984-Sarajevo

1988-Calgary

1992-Albertville

1994-Lillehammer

1998-Nagano

2002-Salt Lake City

2006-Turin

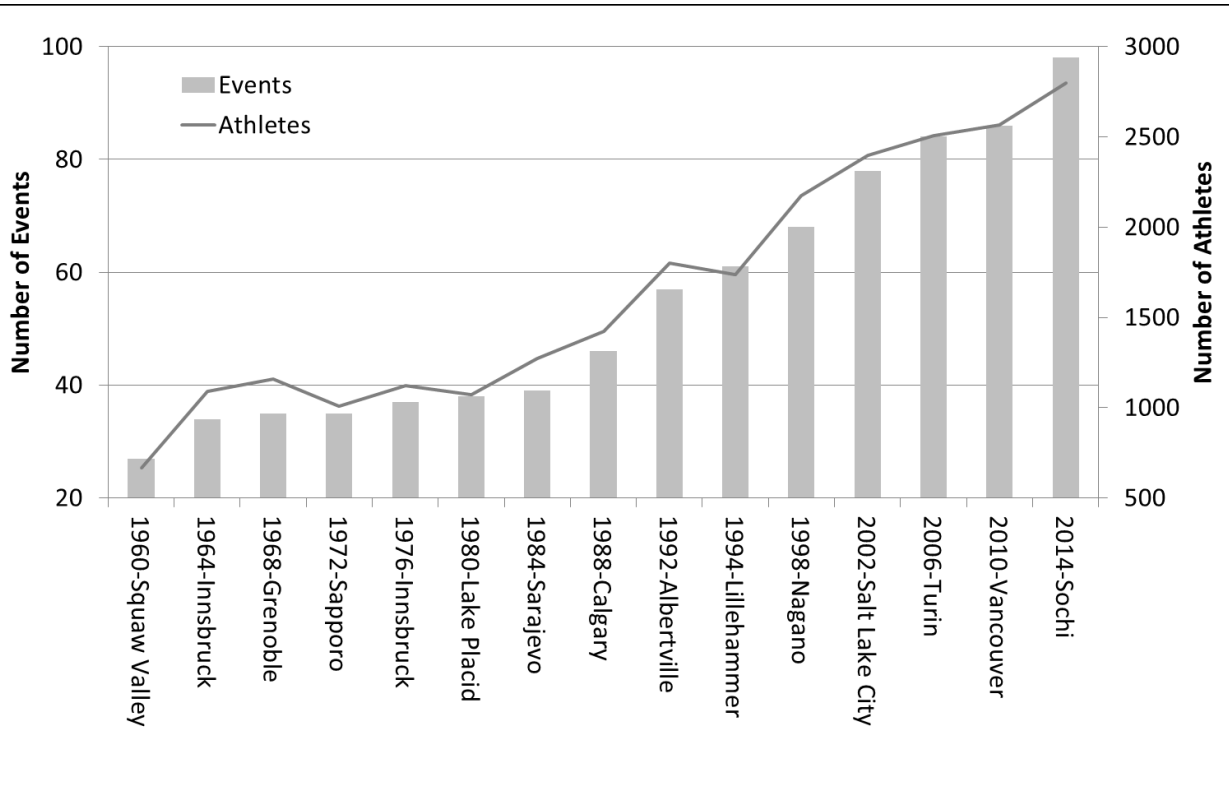
2010-Vancouver

2014-Sochi

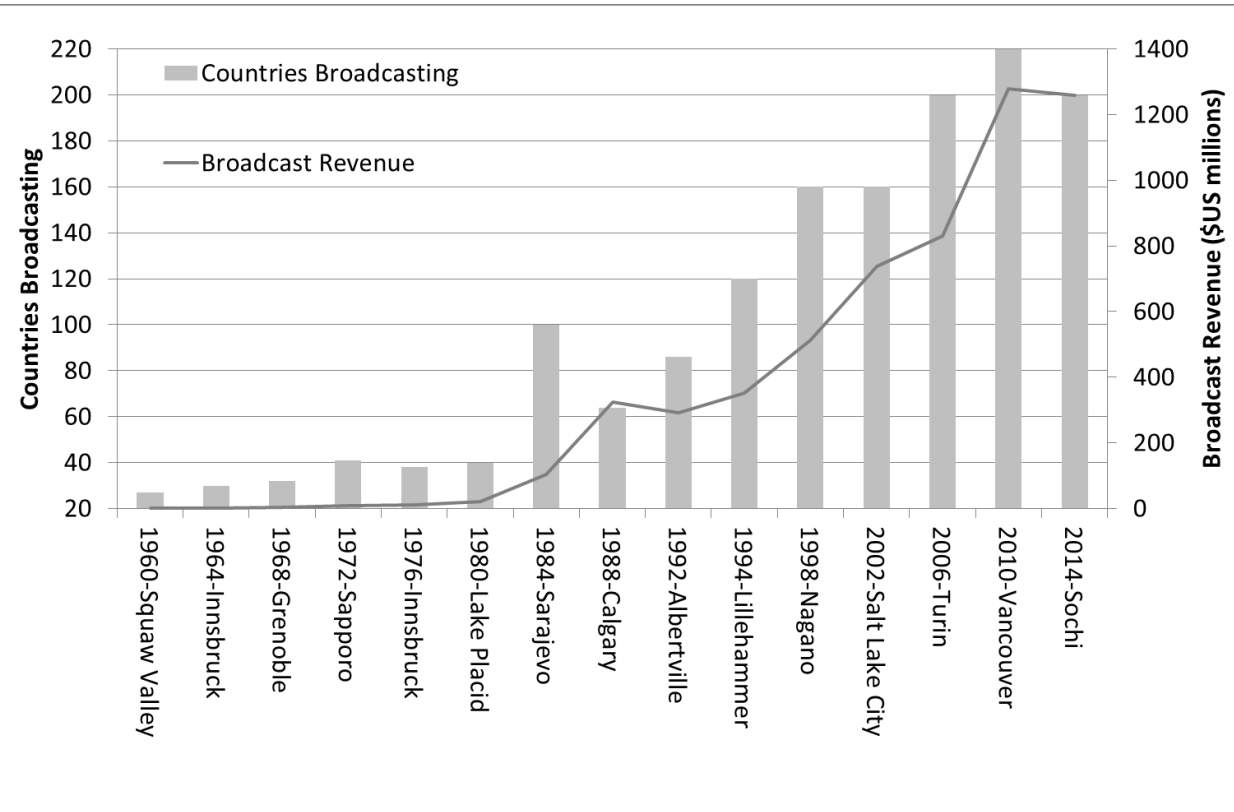
# Challenge 1:

## Games Have Outgrown Most Alpine Destinations

### Scale and Complexity of Planning and Development

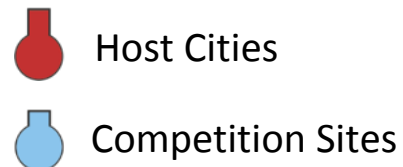
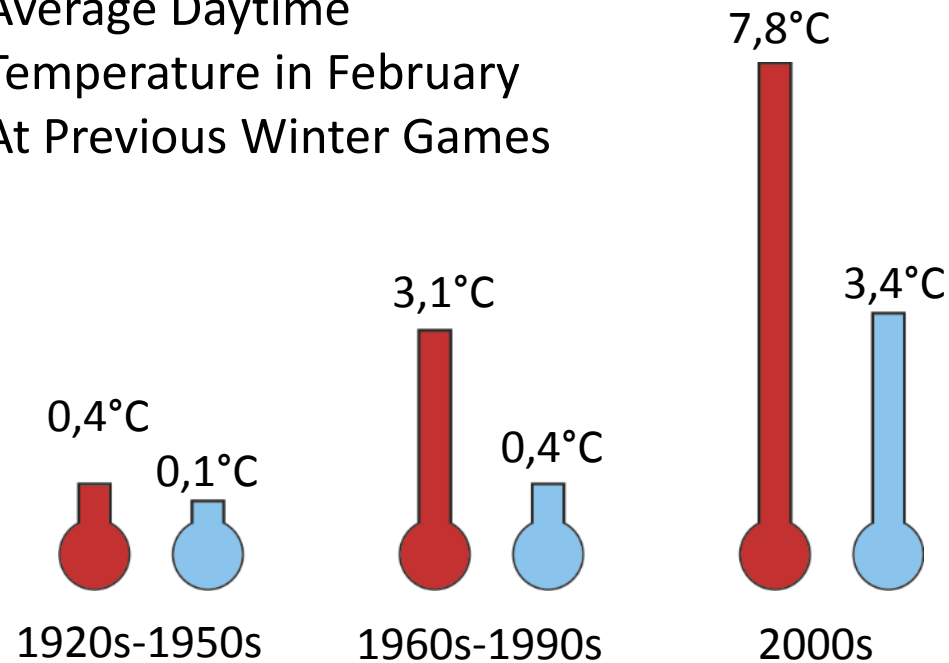


### Commercial Pressures of Event/Media Scheduling

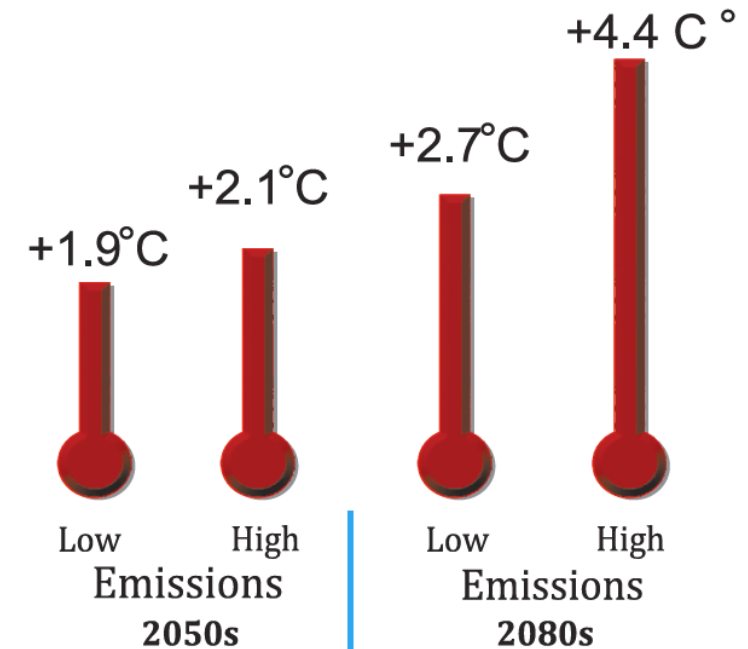


# Challenge 2: Warmer Host Cities

Average Daytime  
Temperature in February  
At Previous Winter Games



Projected Future February Warming  
(above 1981-2010)





# Sochi: An Athletes Perspective



Lara Gut (Switzerland): “There is no snow at the bottom, it’s not funny anymore ... It’s not a race. You are just trying to come down.”



Anton Gafarov (Russia):  
“the course isn’t fit for an Olympics”



- Competitor injury increased 9% and the finish rate decreased 5% in the alpine skiing, freestyle skiing, and snowboarding events in Sochi (2014) vs. Vancouver (2010) (Guisado 2017).
- The injury rate of alpine Paralympic skiers increased 6-fold in Sochi (approximately one-third of competitors sustained injury) and a higher rate of failure to complete (Derman et al. 2018 ).

# Climate Suitability Assessment Approach

Indicator 1



Thermal conditions

>90% probability of minimum daily temperatures of  $\leq 0^{\circ}\text{C}$

Indicator 2

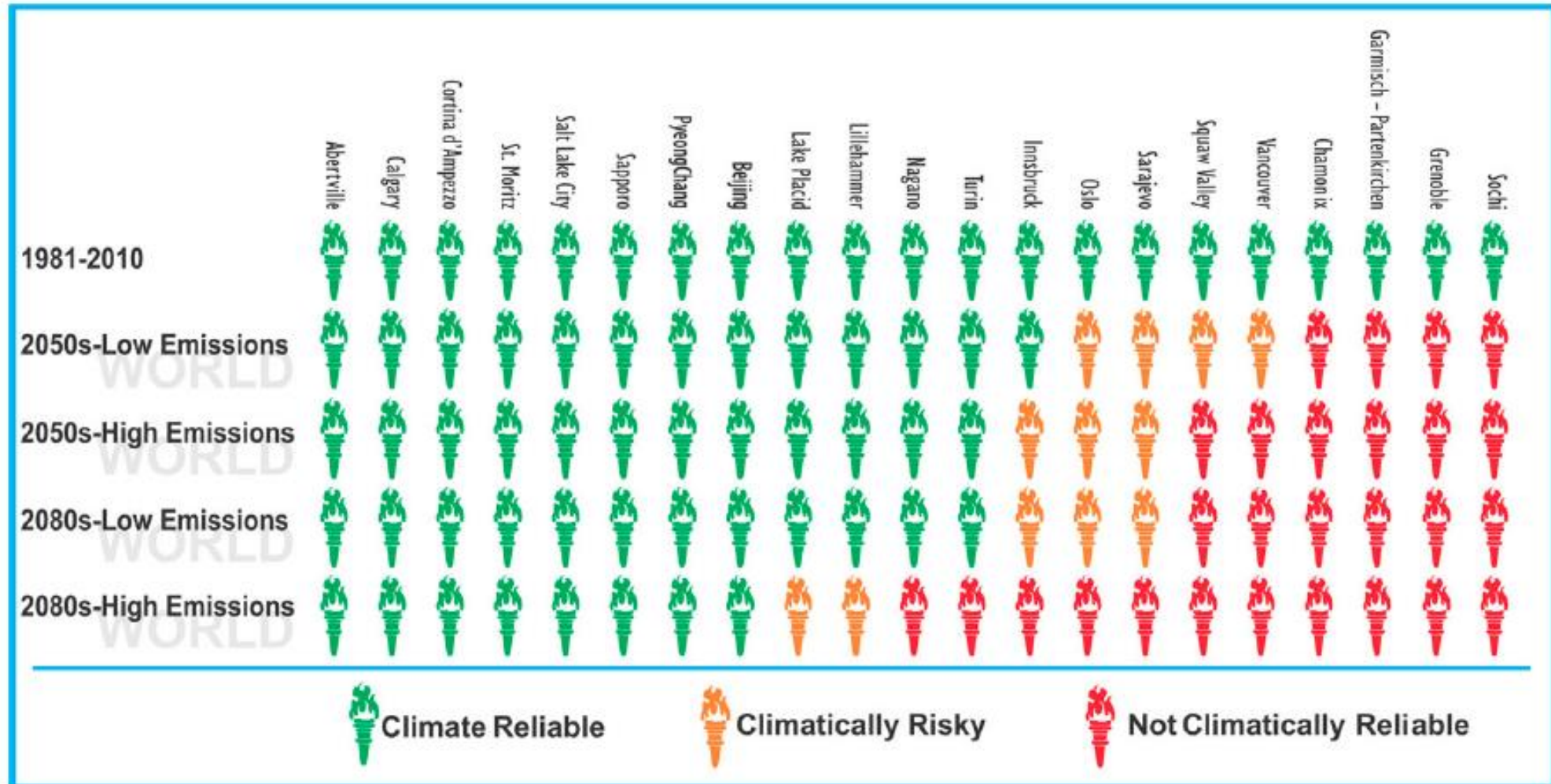


Snow reliability

>90% probability of snow depth  $\geq 30$  cm with advanced snowmaking

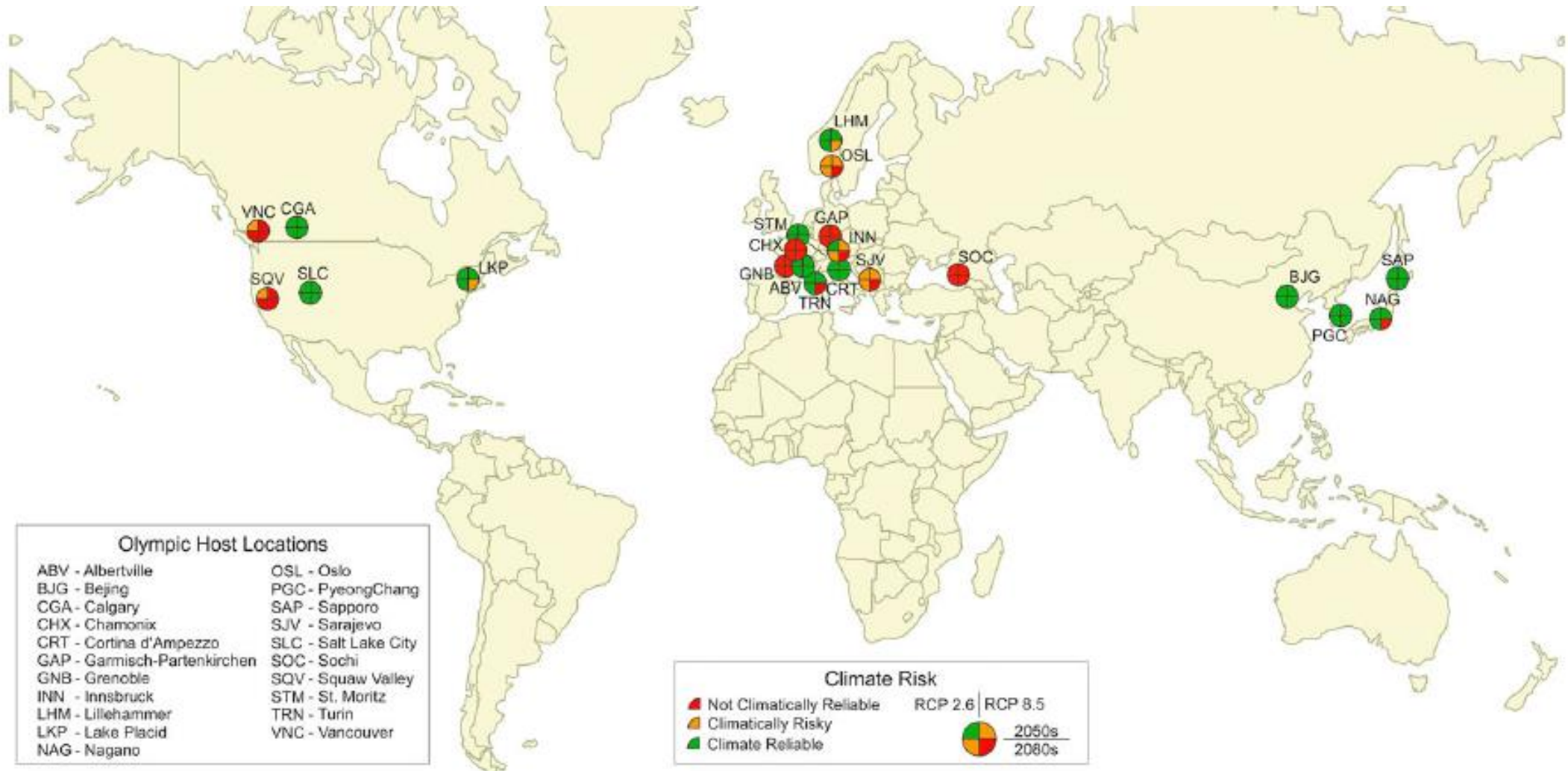
Two climatic indicators are used to assess the climate reliability of past host cities to hold the games in the future under a low (RCP 2.6) and high (RCP 8.5) emission future.

# Climate Suitability for Future Olympic Winter Games



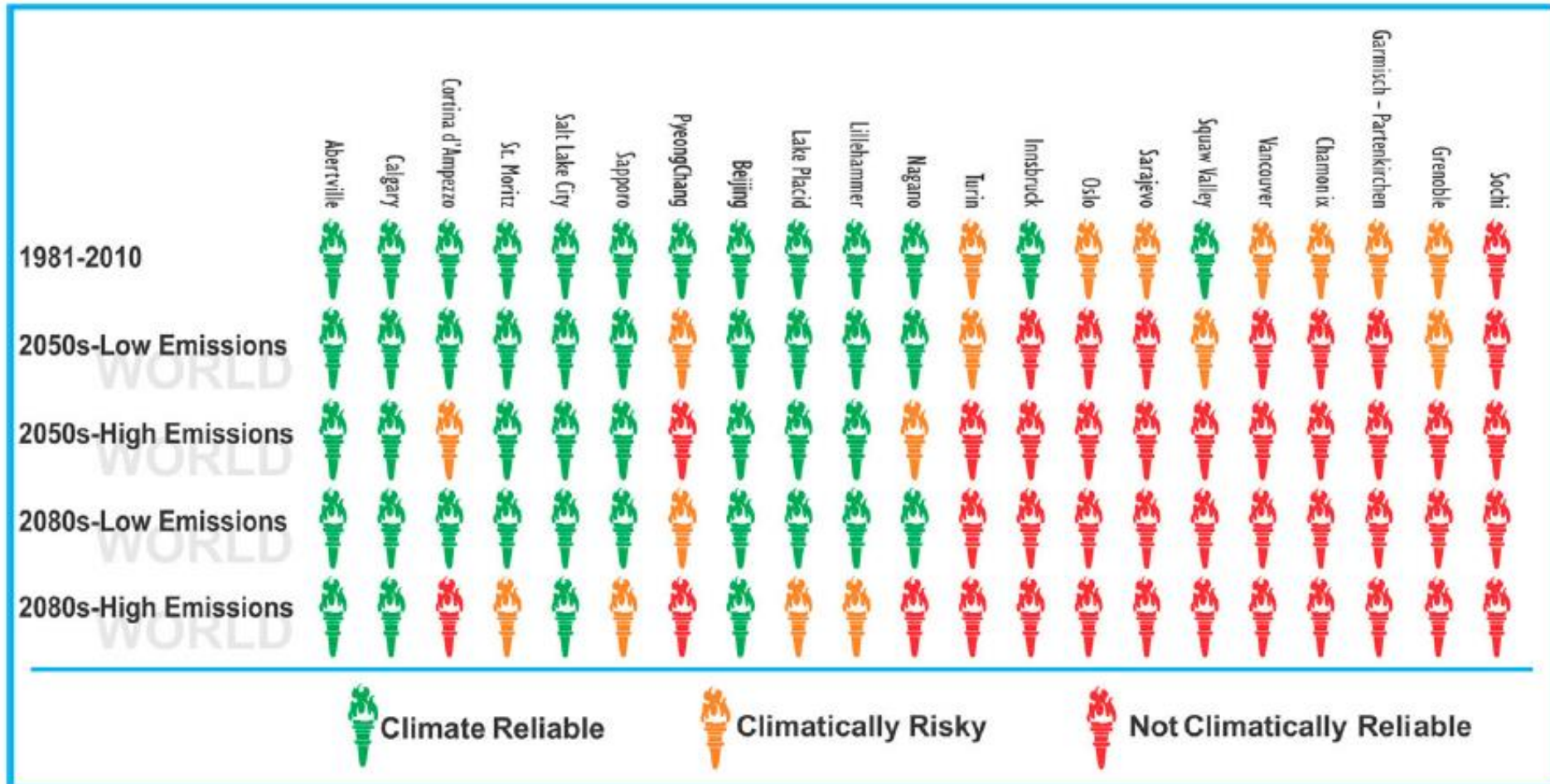


# Climate Change Alters the Geography of the Winter Olympic Games





# Climate Change Will Alter the Timing or Location of the Paralympic Games



# Conclusions: *climate change will ...*

- **Alter the geography** of the winter games and substantially reduce the number of potential host regions.
  - Require some regions interested in hosting the games to bid in near future.
- **Alter IOC bid process** to include sport specific operational thresholds and climate change projections, as well as low carbon operations.
- **Increase the costs** of hosting the games (*forecasting, snowmaking, infrastructure, contingency planning, emission reduction/offsetting*).
- Require a reconsideration of current **Olympic-Paralympic arrangements**.
  - Integration in February would require extending joint games and associated community pressures
  - Multi-national/regional games to pair major city and climate reliable mountain community
- Need **leadership by the IOC** in the global sports community.



United Nations Climate Change  
Global Climate Action

### **Question 3:** What are **key challenges** of hosting major events in alpine tourism destinations and how should destinations act in the context of bidding and hosting such sports events?"

- The Olympics and Paralympics have **outgrown** virtually all alpine destination communities. Partnerships with major cities are required to minimize adverse impacts on alpine destinations.
- Climate change will reduce the number of alpine destinations capable of hosting the games. Some with ambitions to host need to bid **sooner rather than later**.
- Commitments to **sustainability/low carbon** games/events are paramount in future bids.



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