OLIVER WYMAN

Corporate Risk

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City of Chicago Analysis of Economic Impacts from Climate Change

Craig Faris, Partner

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Contents

1. **Project background**
2. **The model**
3. **Select key findings examples**
4. **What is required to conduct economic analysis of climate change in a large metro area?**

Section 1

Project background

Project background
Chicago Climate initiative

- The Chicago Climate Task Force was created to achieve the following goals
  1. Identify the likely climate change scenarios for the City of Chicago
  2. Understand the economic impacts of climate change
     a) Identify key areas of focus based on differential economic impacts and the ability of the city to address them
  3. Develop a specific set of mitigation and adaptation options

Project background
Oliver Wyman's role

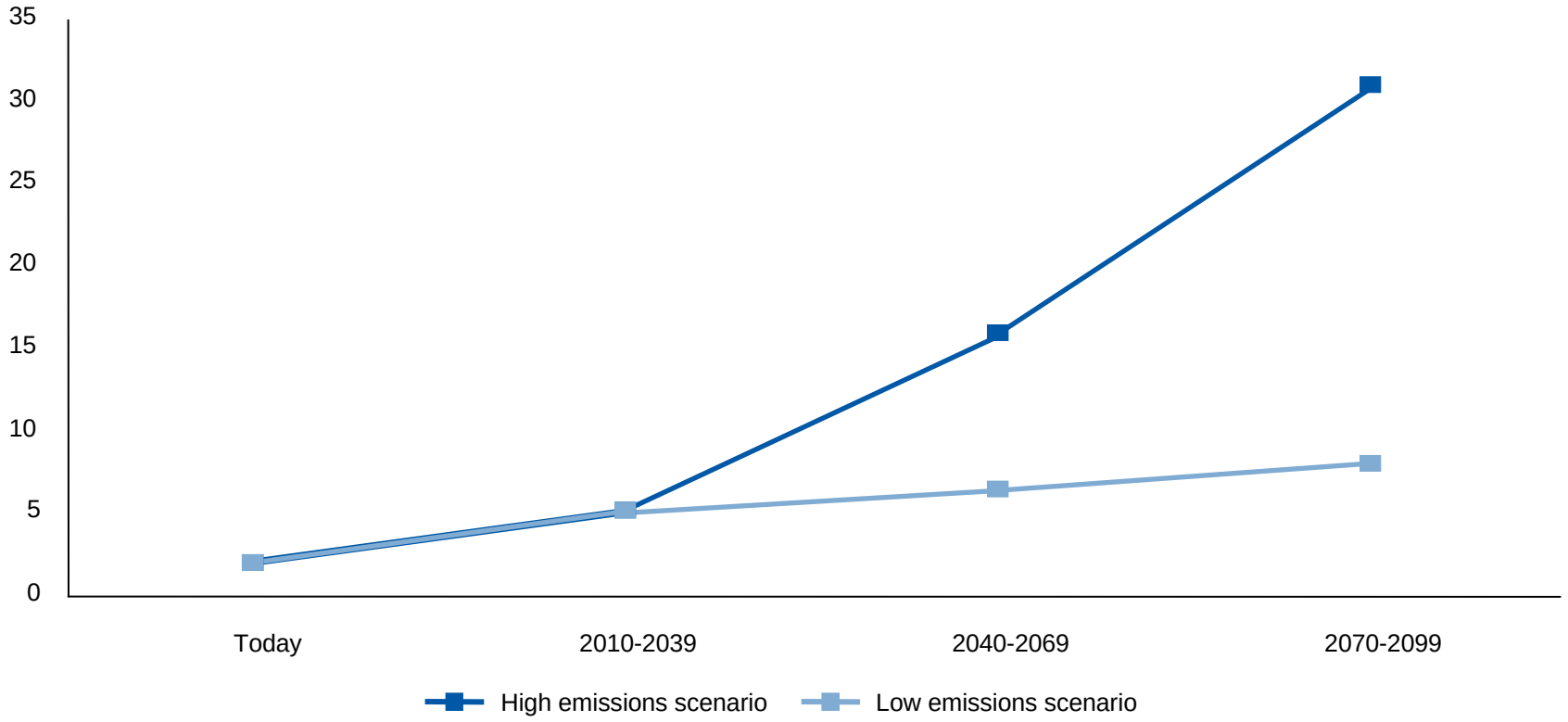
- Oliver Wyman was engaged to assist the Task Force with modeling the economic impacts of climate change on the City of Chicago for the years 2010-2099

  - 18 departments and related agencies were interviewed to determine how they would be affected by climate change
  - The scope of analysis included only the City government and related agency cost/ revenue structure
  - Impacts were modeled under two scenarios
    - High emissions
      - Resulting from continued dependence on fossil fuels
    - Low emissions
      - Resulting from a shift to alternative energy sources
  - Economic impacts were grouped by
    - Period (e.g. near, mid, end century)
    - Climate Driver (e.g. average temperature, average precipitation)
    - High-Level Driver (e.g. energy demand, maintenance)
    - Area (e.g. ecosystem, water, health)
    - Type of expenditure (e.g. operational cost, capital investment)

Climate change projection

Heat days – Impacts energy, ecosystems, and revenue generation

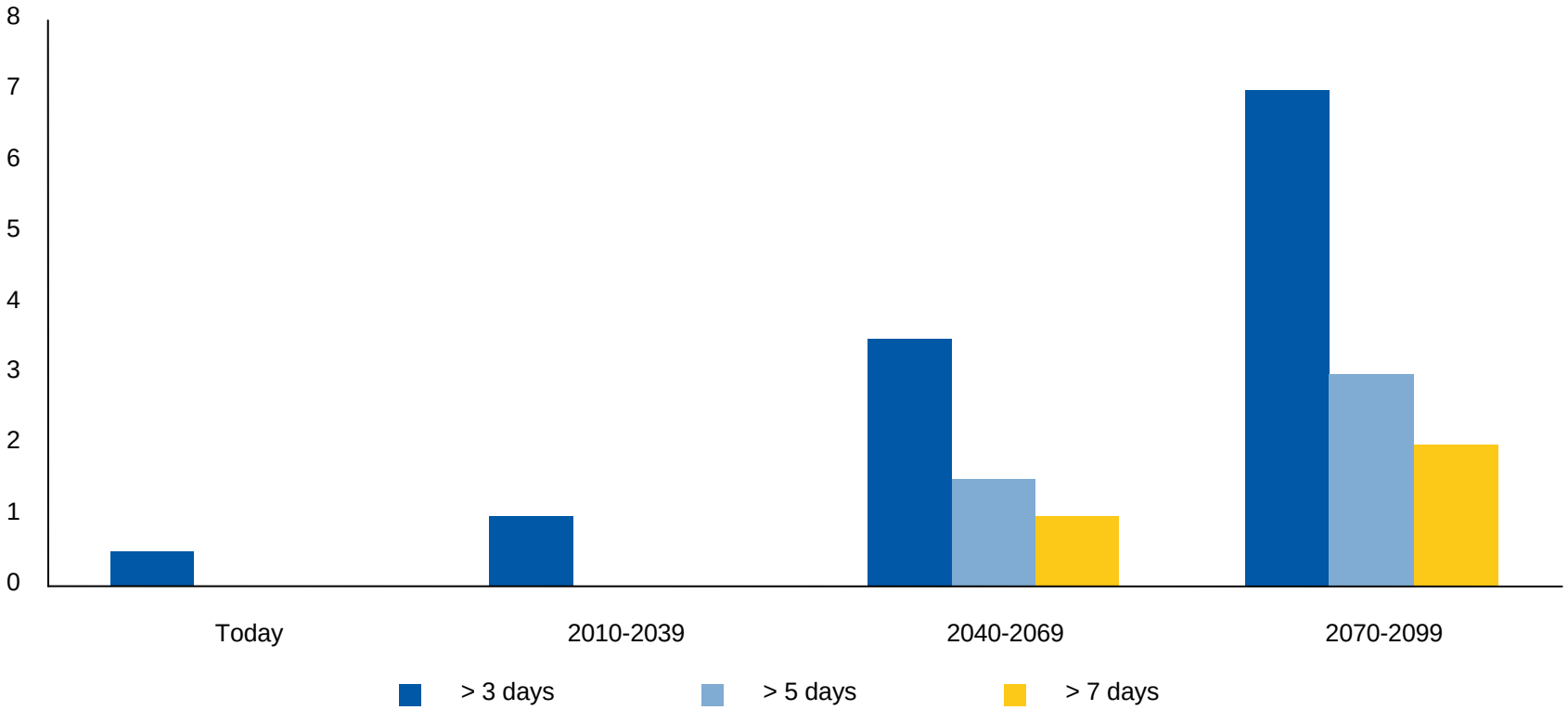
Total number of days >100 degrees



Climate change projection

Consecutive heat days

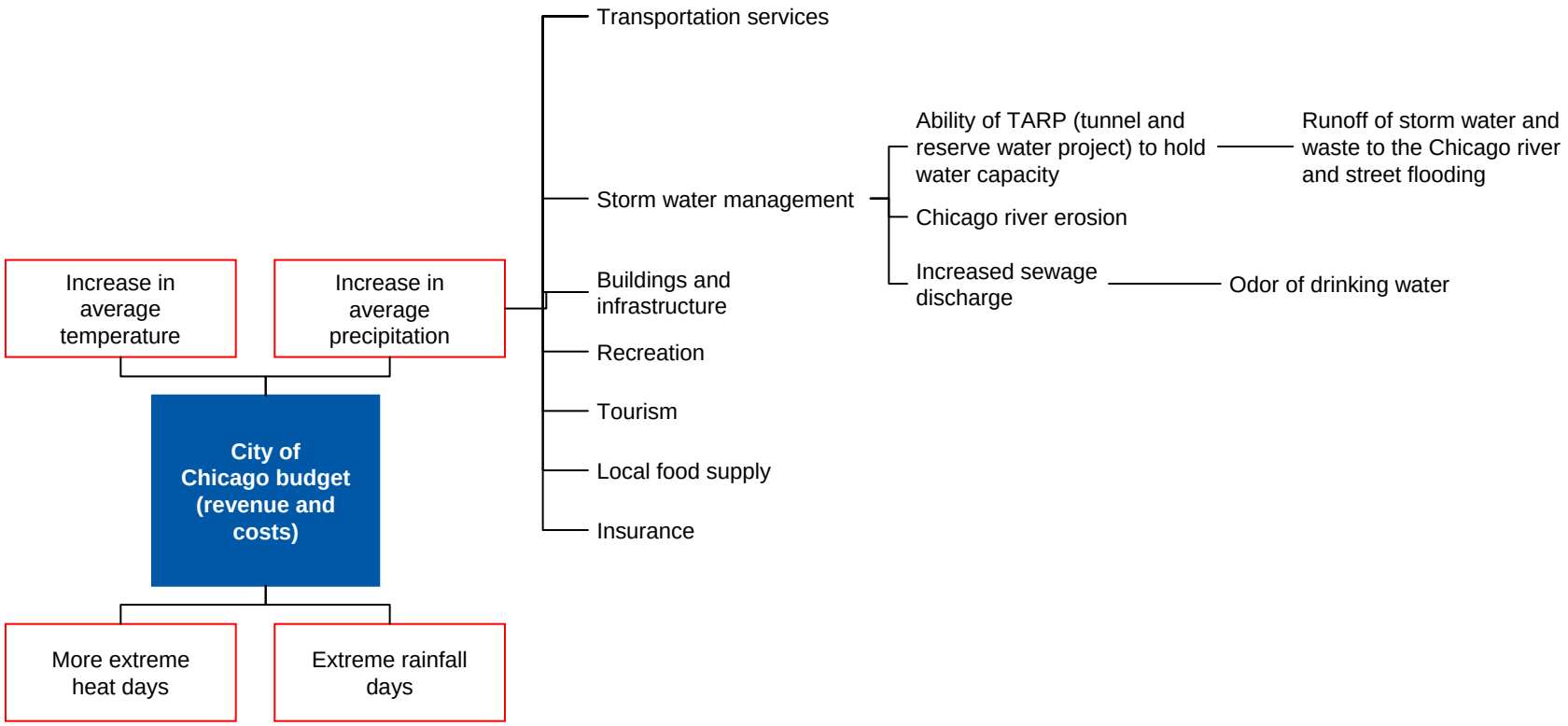
Consecutive days >100 degrees F
(High emissions scenario)



Section 2

The model

Based on recent climatological studies, four main drivers were used to form the starting point for all “risk impact pathways”

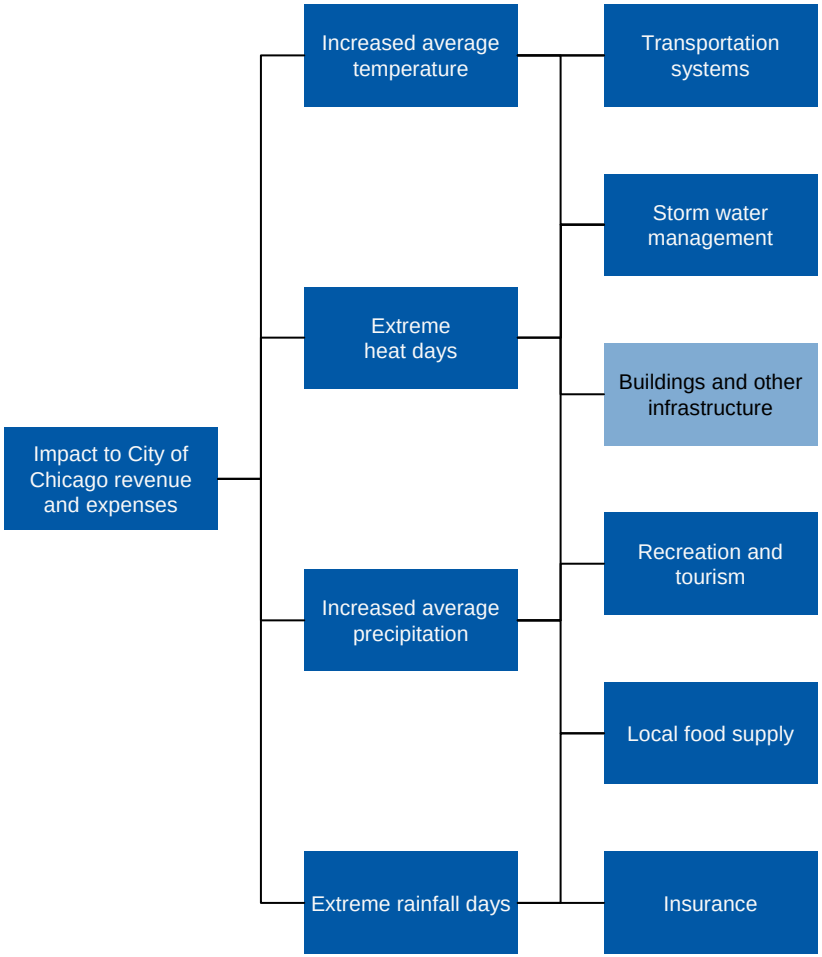


A finite set of patterns guided the analysis for all impact pathways

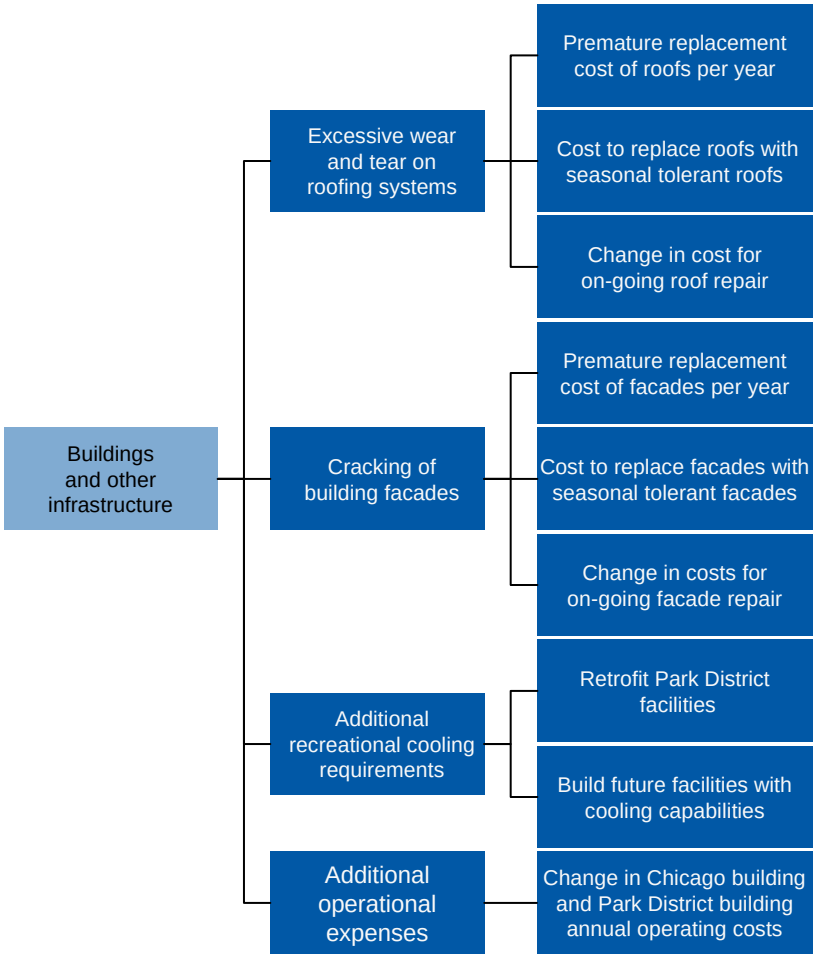
- **One time impact to costs or revenue**
  - Timing of cost will fall between a range of dates
    - Increased Avg. Temp: Retrofit park indoor athletic facilities with air conditioning
      Move lake water intake cribs further off-shore
- **New ongoing impact to cost or revenue**
  - Start date will fall between a range of dates
  - Period of ramp up to max cost will fall between durations
    - Increased Avg. Temp: Increased treatment of algae growth in lagoons
    - Extreme Heat Days: Decreased attendance at Outdoor Summer Cultural Events
- **Premature Replacement costs**
  - As the heat increases, the life span of existing equipment and building is shortened requiring premature repair or replacement
  - Assume that once repaired or replaced, that lifetimes return to status quo
  - Start date of premature replacement will fall between a range of dates
  - Duration of premature replacement will fall between a range of durations
  - Will assume linear ramp up to mid-point of the duration and linear ramp down
    - Increased Avg. Temp: Replacement of CTA Rail
      Replacement of CTA Buses
      Tree replacement

Each impact pathway had a series of drivers organized in cause and effect chains and served as the basis for risk quantification

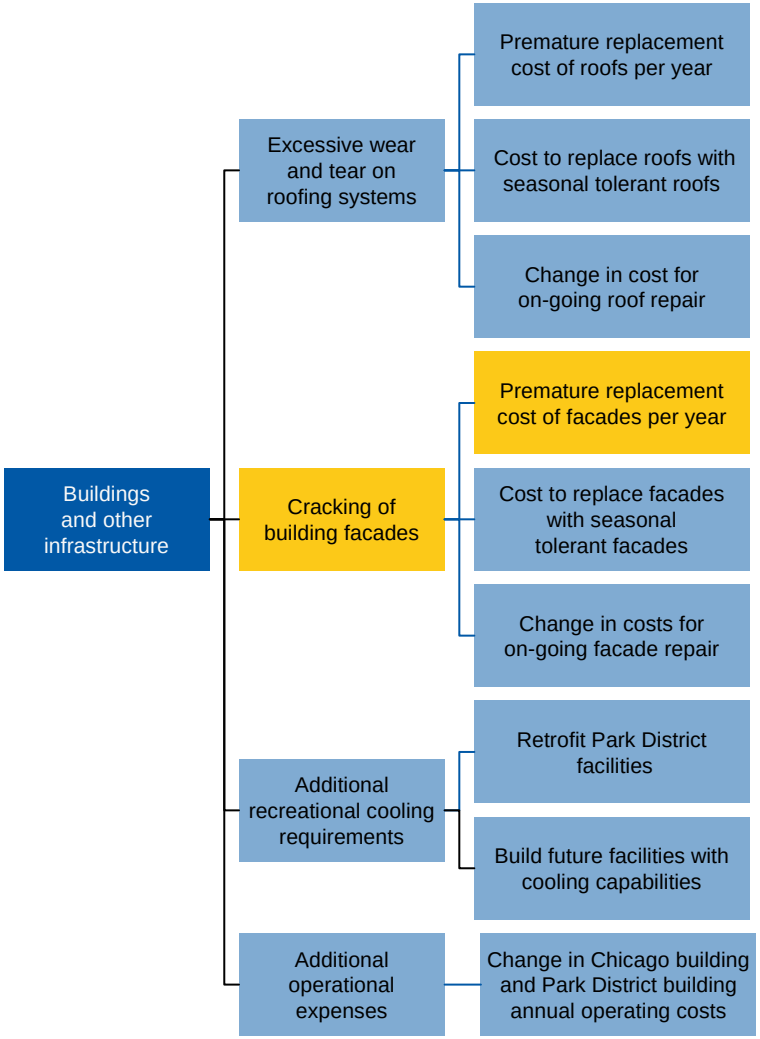
Impact pyramid example
Impact to revenue and expenses



Increased average temperature example
Buildings and other infrastructure

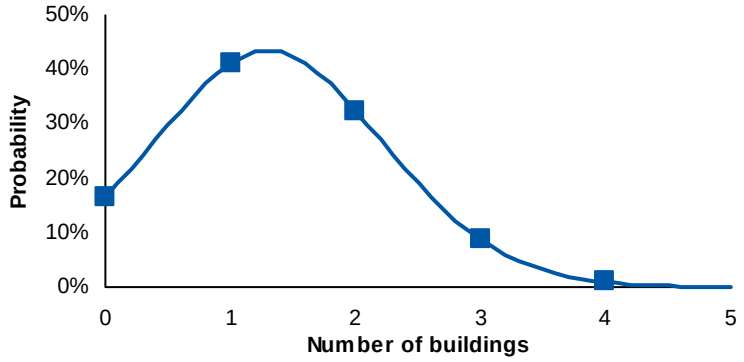


Each pathway and set of drivers was quantified to yield probability and impact distributions

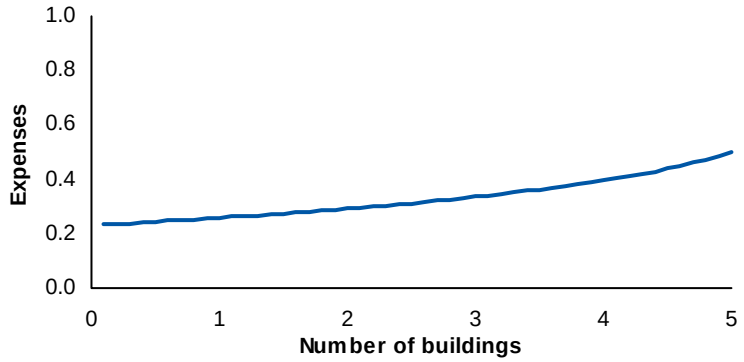


Quantification example for "cracking of buildings due to summer attributes"

Probability distribution
Shortening lifespan of buildings

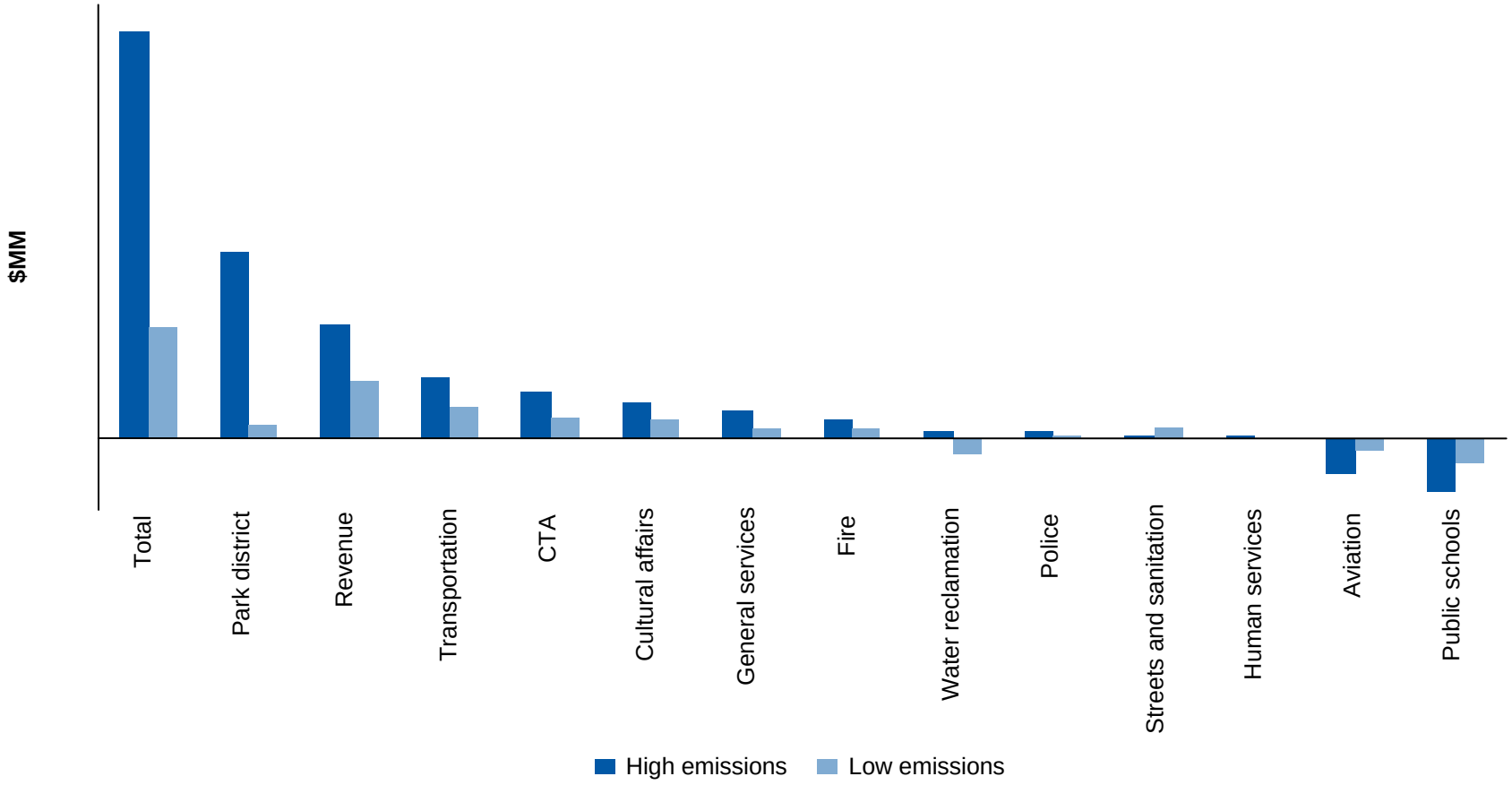


Impact distribution
Increased costs to repair the facade of the buildings



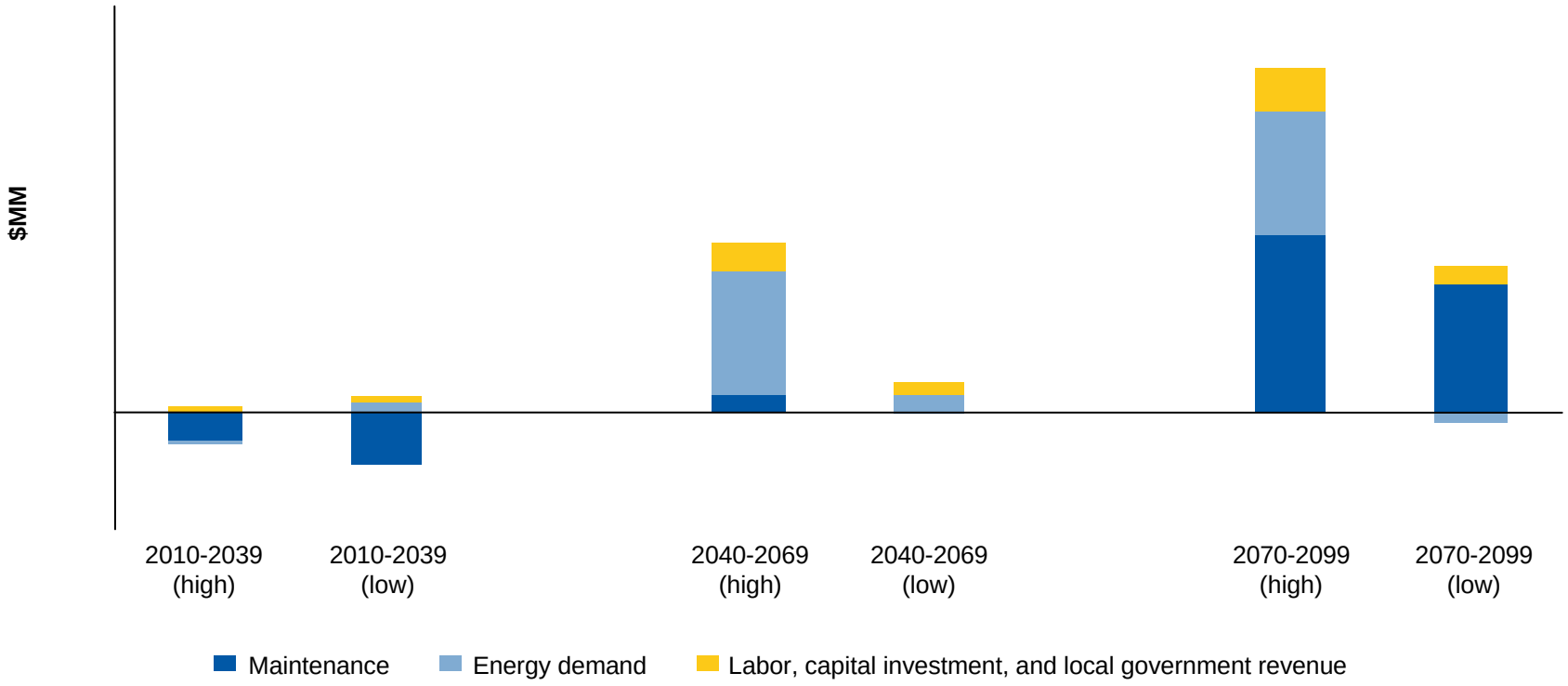
Those distributions were integrated within the model with the City expert costs assumptions to yield multiple views and detailed economic impact assessments

Average additional annual cost in 2007 $ by department



Example economic impact assessments (cont'd)

Average additional annual cost in 2007 $ by expenditure type



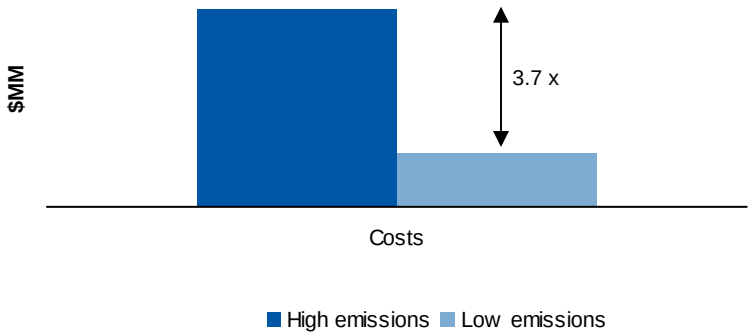
Section 3

Select key findings

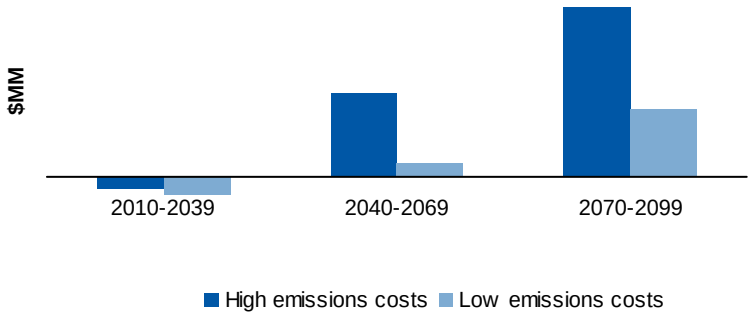
Key findings
Overall results

- The total economic impact of climate change on the City of Chicago for the period 2010-2099 was $2.54 BN under high emissions and $690 MM under low emissions
- Annual costs to the city increase significantly with time
- Near-term annual savings are due to Metropolitan Water Reclamation District decreased pumping costs (due to lower precipitation levels)
  - With the MWRD impact removed, the near-term effect to the city is a net cost
  - Costs under high emissions are less than under low emissions in the near-term due to heating savings

Total economic impact 2010-2099



Additional annual cost by period

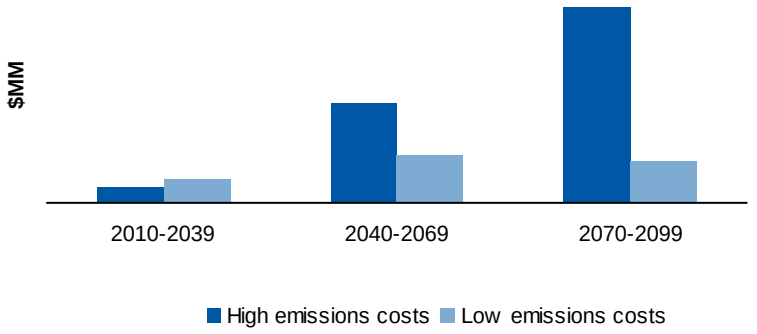


Key findings

By climate driver: A closer look at temperature effects

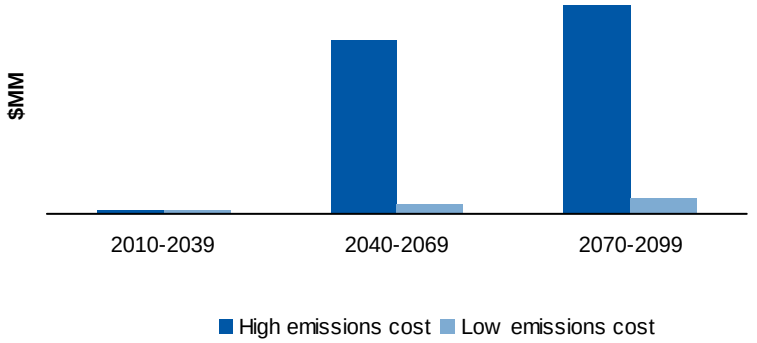
- The overall impacts of average temperature under high emissions are two and a half times as high as those under low emissions
  - At the end of century, they become nearly five times as high

Annual costs due to average temperature increases over time



- The overall high emissions impacts of extreme heat days are thirteen times as large as those under low emissions
  - Costs associated with extreme heat are primarily driven by capital expenditures and energy demand

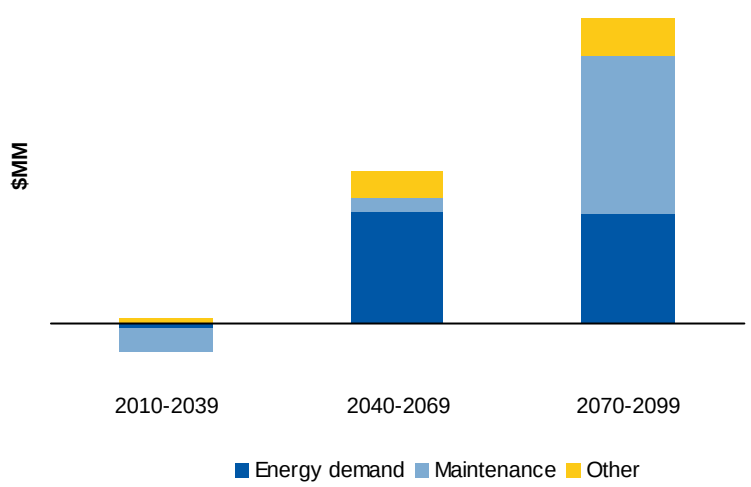
Annual costs due to increase in extreme heat days over time



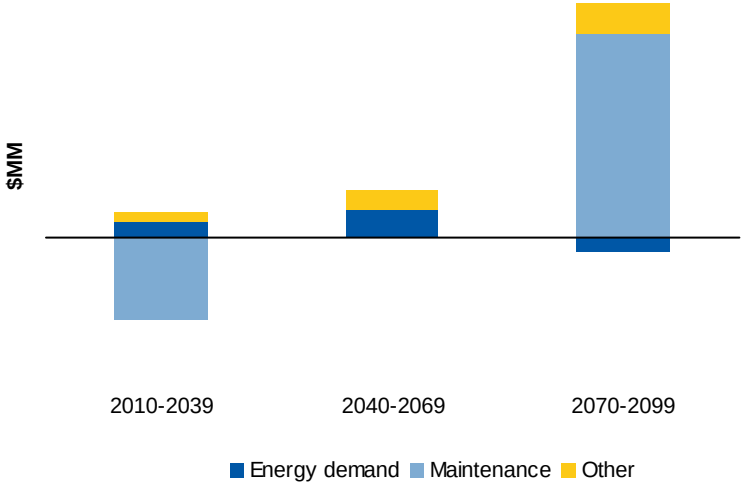
Key findings
By type of expenditure

- The bulk of economic impacts to the City of Chicago come from energy demand and maintenance, especially under high emissions

Annual costs by high-level driver over time (high emissions)



Annual costs by high-level driver over time (low emissions)



- Annual energy costs are nearly fourteen times higher in the high emissions scenario than in low emissions
- This may indicate that adaptation efforts related to energy efficiency and climate adjusted maintenance could provide significantly leveraged mitigation results

Section 4

What is required to conduct economic analysis of climate change in large metro area?

Requirements for economic analysis

- Reliable climate projections – these serve as the basis for impact estimates
- A base level knowledge among departments of the importance and relevance of the projections
- A good understanding of potential impacts for each department e.g. what will happen to building facades if average temperatures increase?
- Reasonable cost estimates for specific operations, actions, investments
- Interdepartmental discussions to appreciate the implications of their actions i.e., avoidance of unintended negative effects

Benefits of detailed economic impact analysis

- Provides the ability to focus mitigation/adaptation efforts on high impact areas
- Highlights the variable affects of climate change on departments and agencies
- Provides a ‘wake-up’ call as to the impacts on the City and surrounding areas
- Allows more proactive and informed planning and capital budgeting
- Creates a clearer, shared platform for understanding in climate change discussions

Questions?

Craig Faris

Partner, Oliver Wyman

Craig.Faris@oliverwyman.com

202-263-7623

On the web

www.oliverwyman.com