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## City of Chicago Analysis of Economic Impacts from Climate Change

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NYC-MQW/CF1MKT-041

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### 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 options

## Project background

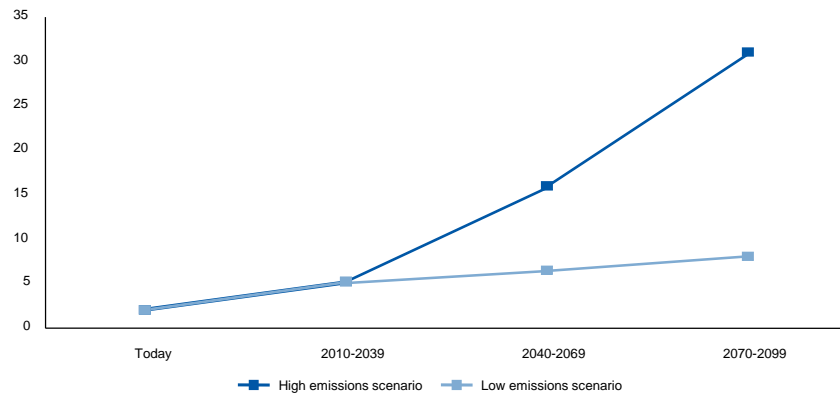
### Oliver Wyman's role

- 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 example

Heat days – Impacts energy, ecosystems, and revenue generation

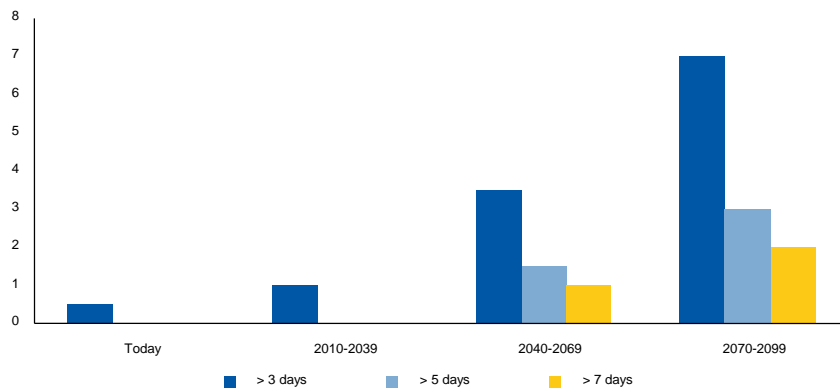
Total number of days >100 degrees



### Climate change projections example

Consecutive heat days

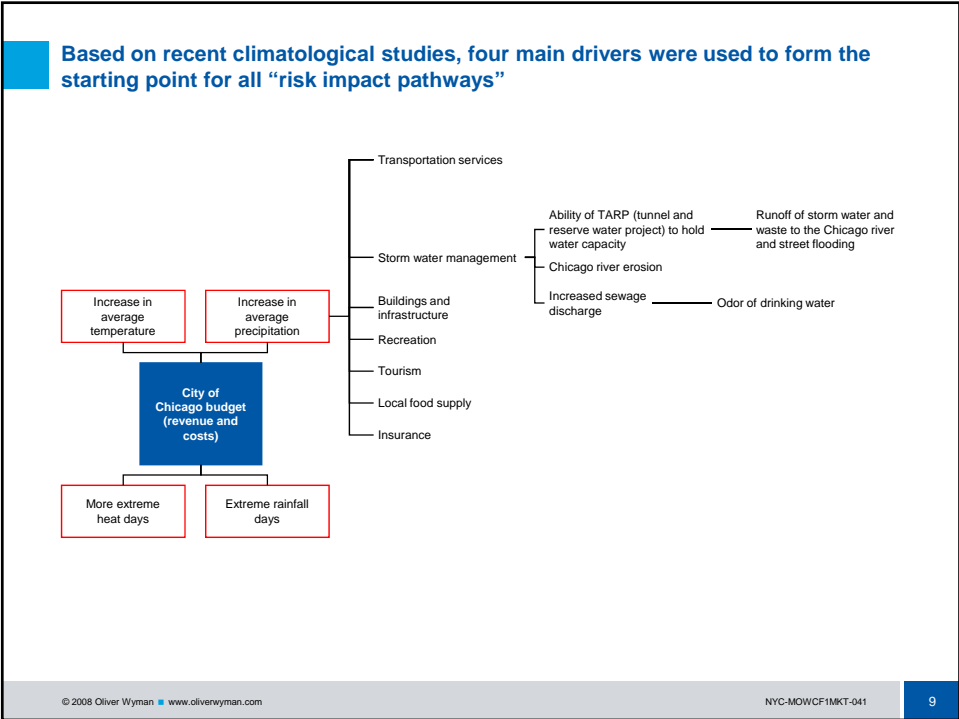
Consecutive days >100 degrees F  
(High emissions scenario)



Section 2

# The model

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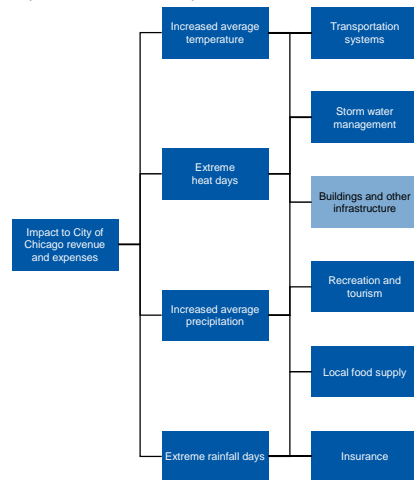
**A finite set of patterns guided the analysis for all impact pathways**

- **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**

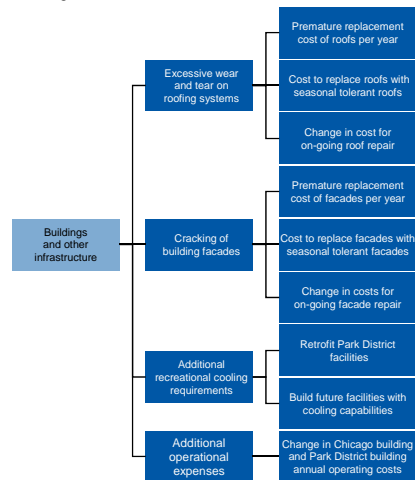
**Impact pyramid example**

Impact to revenue and expenses

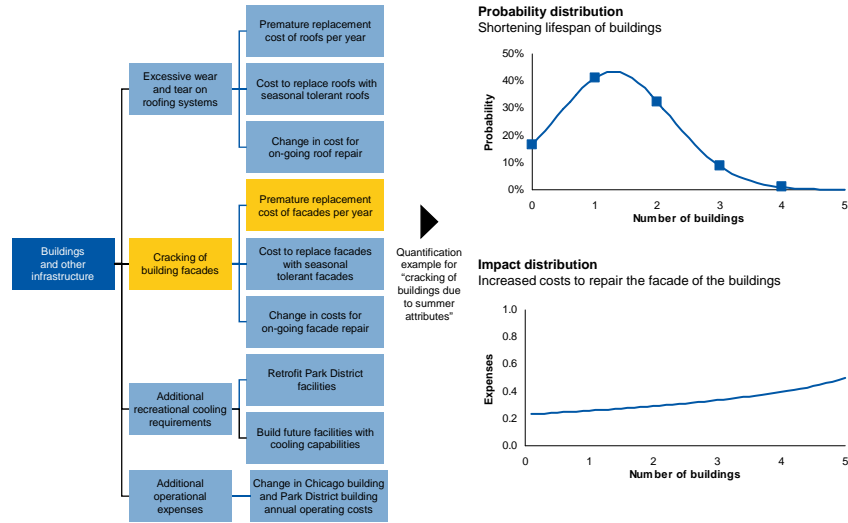


**Increased average temperature example**

Buildings and other infrastructure

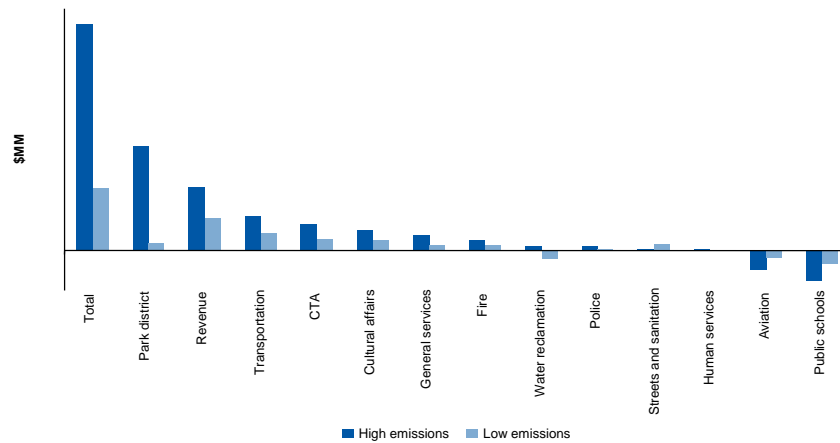


**Each pathway and set of drivers was quantified to yield probability and impact distributions**



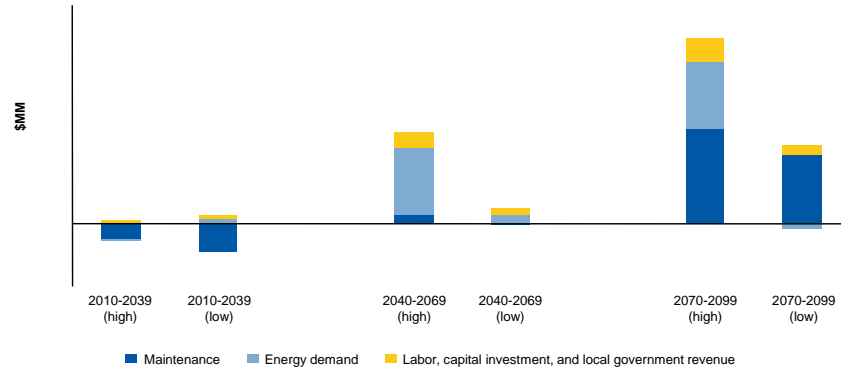
**Those distributions were integrated within the model with the City expert costs assumptions to yield multiple views and detailed economic impact assessments**

**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

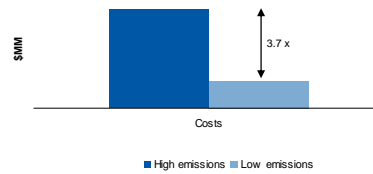
## Select key findings

## Key findings

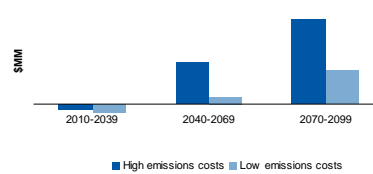
### Overall results

- The total economic impact of climate change on the City of Chicago for the period 2010-2099 was **\$X BN** under high emissions and **\$XXX 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

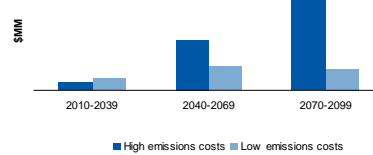


## Key findings

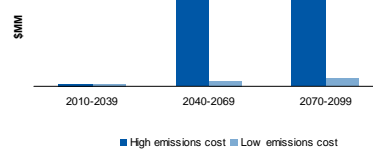
### By climate driver: A closer look at temperature effects

- 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
- 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 average temperature increases over time



#### Annual costs due to increase in extreme heat days over time

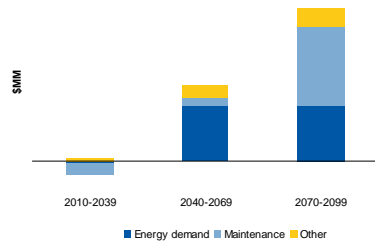


## Key findings

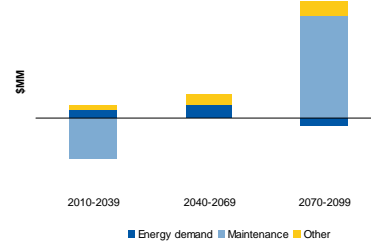
### By type of expenditure

- 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?

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