Corporate Risk Case Study:

City of Chicago Climate Change Task Force

CHICAGO CLIMATE ACTION PLAN

by Oliver Wyman • July 2008

Confidentiality

Our clients' industries are extremely competitive. The confidentiality of companies' plans and data is obviously critical. Oliver Wyman will protect the confidentiality of all such client information.

Similarly, management consulting is a competitive business. We view our approaches and insights as proprietary and therefore look to our clients to protect Oliver Wyman's interests in our presentations, methodologies and analytical techniques. Under no circumstances should this material be shared with any third party without the written consent of Oliver Wyman.

This research was commissioned to advise the Chicago Climate Task Force in the development of the Chicago Climate Action Plan. It does not represent official City of Chicago policy.

Introduction

In July 2007, the City of Chicago engaged Oliver Wyman to help the Chicago Climate Task Force model potential economic impacts of climate change on the city over the period 2010-2100. This preliminary analysis provided a deeper understanding for the City of economic changes stemming from climate effects, both operational and facilities related. The study represents a breakthrough approach for detailed and actionable analysis consistent with the City of Chicago's leadership position on environmental responsibility and stewardship.

The study was focused specifically on city infrastructure, key departments and budgets and was designed to yield insights for adaptation and mitigation planning, both on departmental and citywide levels. Five primary considerations were addressed

1. Areas that would be most affected from a financial perspective
2. Primary impact drivers (e.g. heat, precipitation)
3. Nature of the impact (e.g. deterioration of building facades)
4. Type of financial impact (e.g. capital investment, operational costs)
5. Magnitude of potential impacts

The analysis was done to assist city leadership in development of effective adaptation plans for adjusting to climate change-related effects on the city and well informed mitigation plans for reducing the city's overall greenhouse gas emissions. Information regarding potential climatic changes and their effects on the city's weather was drawn from the work of Donald Wuebbles of the University of Illinois and Katherine Hayhoe of Texas Tech University.

The Oliver Wyman model included a "business as usual" scenario (i.e. current operational levels and authorized investments) to provide a solid baseline for evaluation of incremental costs stemming from anticipated climate changes. The analysis did not account for possible technological advances, due to uncertainty of timing and effectiveness, although advances can be integrated in subsequent updates of the dynamic model.

The model represents an in depth integration of multiple data sources with a complex risk-based analytical toolset in order to yield a broad range of economic insights. Development of the model included two fundamental steps.

The study focused on city infrastructure, key departments and budgets.

Step 1: Critical information gathering, compilation and level-setting

The Oliver Wyman research team identified and interviewed numerous content experts from 18 city departments to determine the extent to which their respective department's operations, assets, personnel and services would be physically and operationally affected by projected climate changes. These changes focused on heat increases (magnitude and duration) and precipitation (frequency and volume). The results of this information gathering and analysis were represented in a series of Climate Impact Pathways (i.e. causal analysis, **Figure 1**) which formed the basis of multiple impact scenarios to capture specific economic dollar impacts by department. Impact scenarios are the series of assumptions built into the model representing possible situations that departments may experience based on climate projections. For example, one scenario for the Fire Department in increased number of extreme heat days would include accelerated rates of vehicle replacement and increased number of fire responses. This type of information should help focus adaptation and mitigation planning on areas of most direct or severe impact. In the Fire Department example the impact is on capital for equipment replacement and increased operational costs.

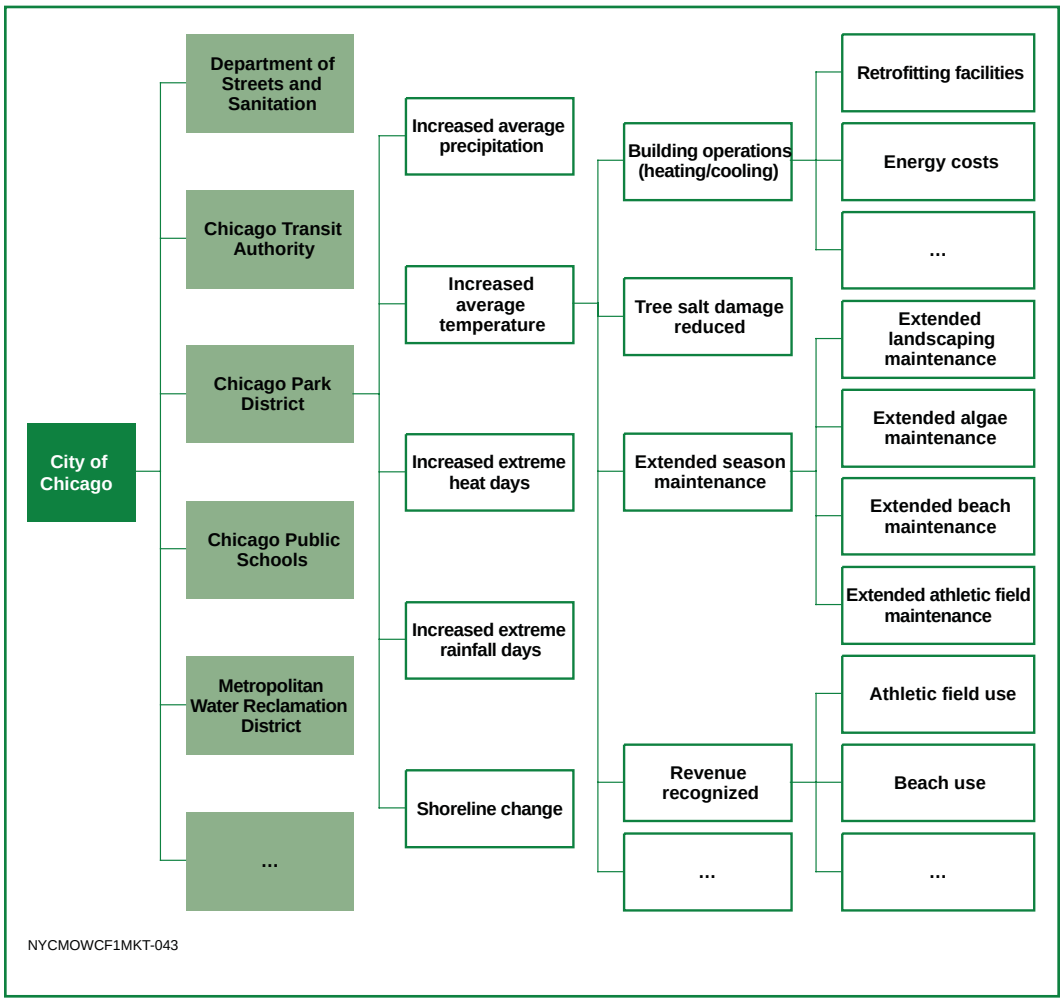


Figure 1: Sample climate impact pathway

Step 2: Development of impact and probability distributions for economic impacts

Oliver Wyman analyzed the economic affect on the City of each potential physical or operational impact (or set of impacts). The research team obtained from each department cost/revenue related data (e.g. equipment replacement, asset repair) that would be anticipated for each specific climate scenario. The data included factors such as, triggers for timing of expenditure, type (e.g. capital investments, increased operating costs), magnitude, new versus incremental costs, etc. These data were run through extensive Monte Carlo simulations to yield a set of unique impact and probability distributions to support reliable cost distribution ranges (**Figure 2**).

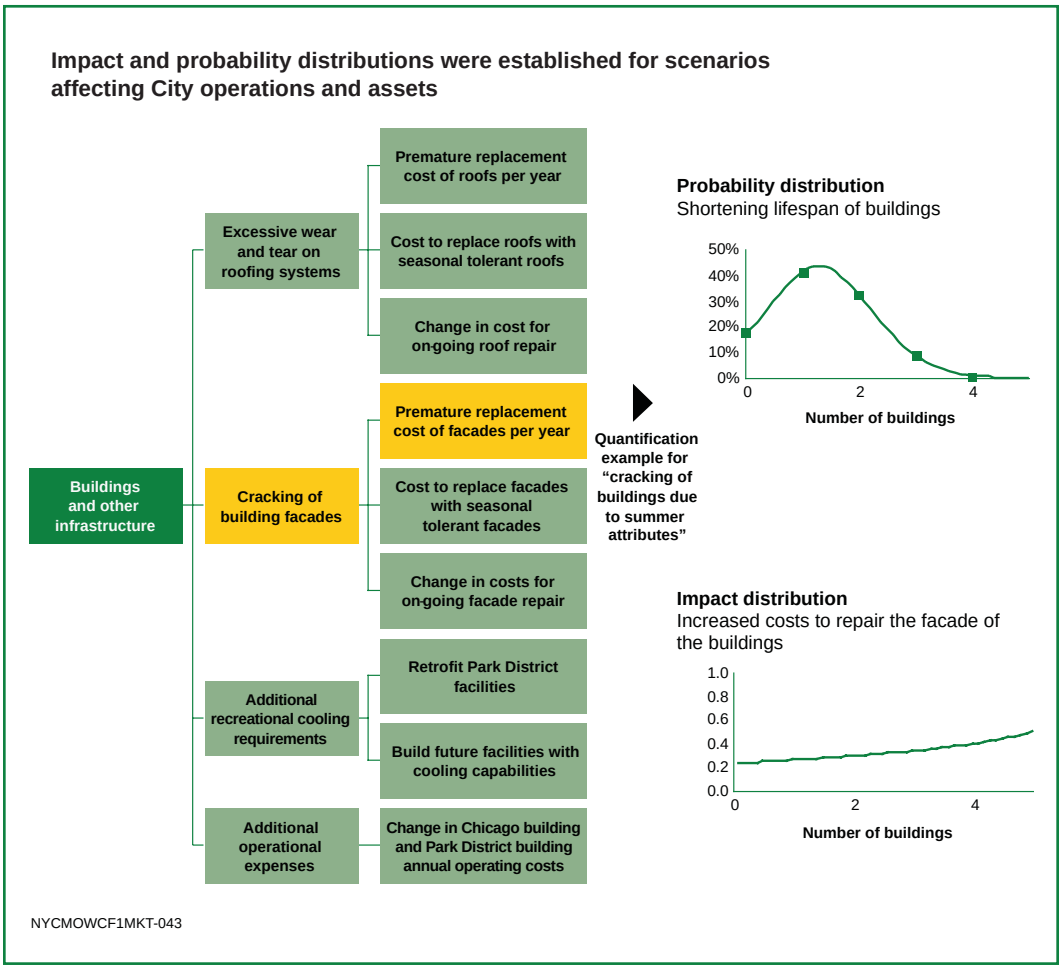


Figure 2: Impact and probability distributions

Results

The model yielded a comprehensive evaluation of potential economic impacts of climate change on the city related to its own internal operations, budgets and capital investment needs on a department by department basis (**Figure 3**, both high and low emissions scenarios). This increased visibility to economic implications provides the opportunity for development of both proactive, preventative solutions and appropriate reactive responses by the City. These plans will enable the City to avoid or lessen potential negative financial impacts and increase the value associated with more forward looking solutions.

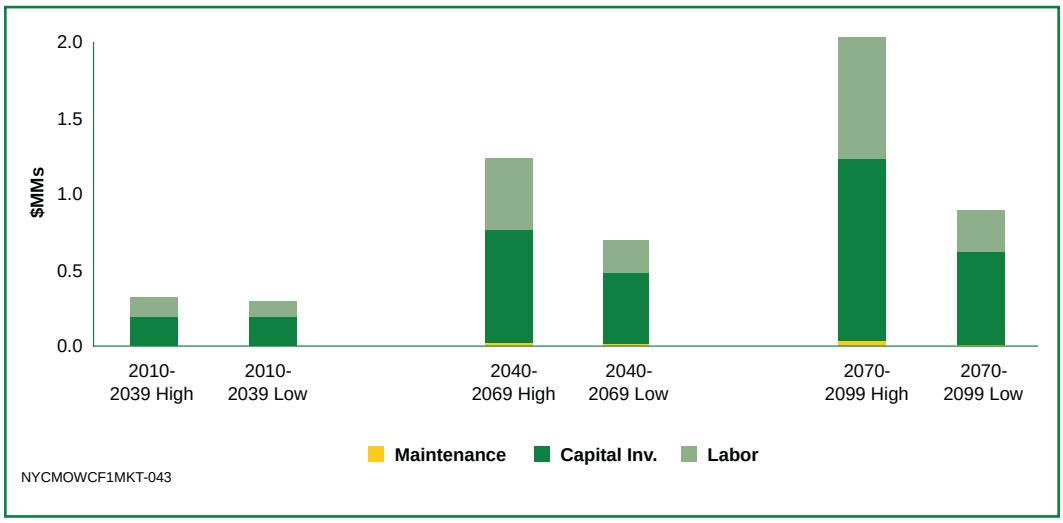


Figure 3: Example annual cost impacts for one department by time period

The exploration of impacts and cost for this study served as the catalyst for a much deeper appreciation of climate impacts on City departments and awareness of the range of potential adaptations. Since the initial compilation of the model in mid-2007, additional departmental climate effects data has been collected and the state of knowledge has increased greatly. Based the nascent departmental understandings when the project began, Oliver Wyman believes the absolute dollar amounts projected by the model are most likely conservative, while the relative distribution of impacts is reliably indicative.

Based on modeled results, Oliver Wyman conservatively estimated the total cost impact of anticipated climate changes on city departments and functions for the 2010-2099 period is $2.54 BN under a “high emissions scenario” and $690 MM under a “low emissions scenario.” The magnitude of variance in impact in each period – and between the high and low emissions scenarios – suggests there is a compelling benefit to pursuing activities which might lead to a lower emissions scenario (in conjunction with the global community). The study concluded that even a partially successful effort to minimize climate effects would have a disproportionately large effect on reducing the negative economic impacts on the city caused by additional operational or capital investments necessary to adapt to climatic changes (**Figure 4**).

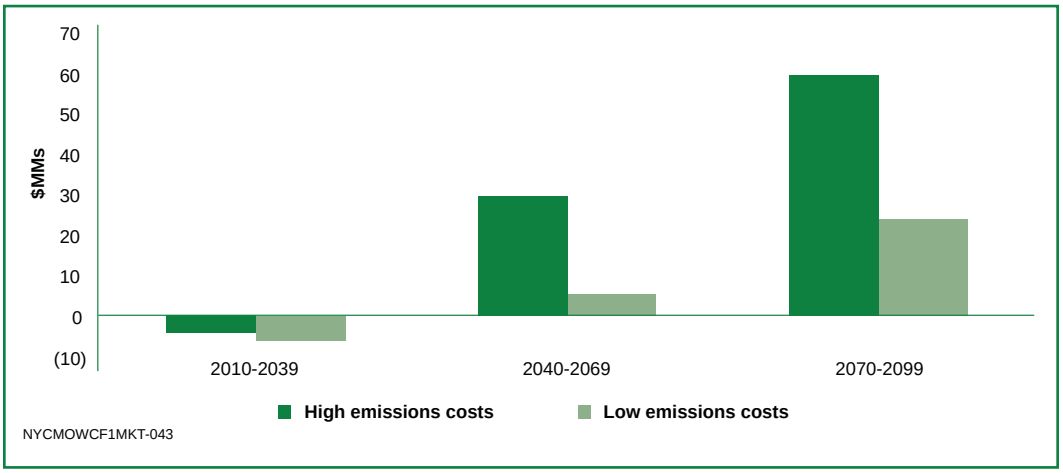


Figure 4: Estimated overall annual cost impacts

The study also found that temperature-related climate changes present the greatest threat to the City's cost and infrastructure (**Figure 5**). Heat-related impacts are a product of changes in both heat intensity and duration. For example, an increase in the annual number of total days with temperatures above 100°F would likely result in dramatic facility and operational changes. Should the number of consecutive days over 100°F increase significantly, an even greater impact would be seen and disproportionately increase negative effects in some departments.

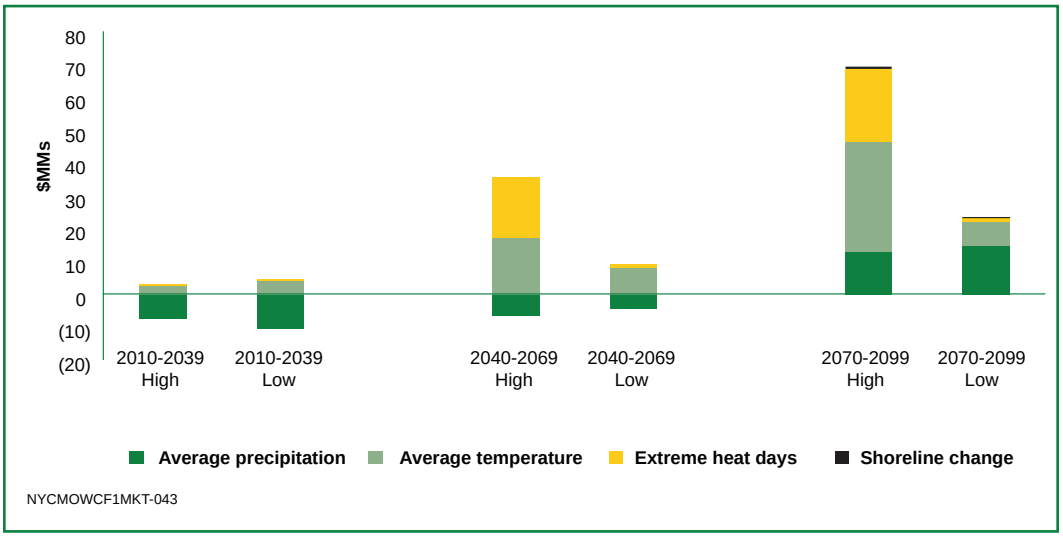
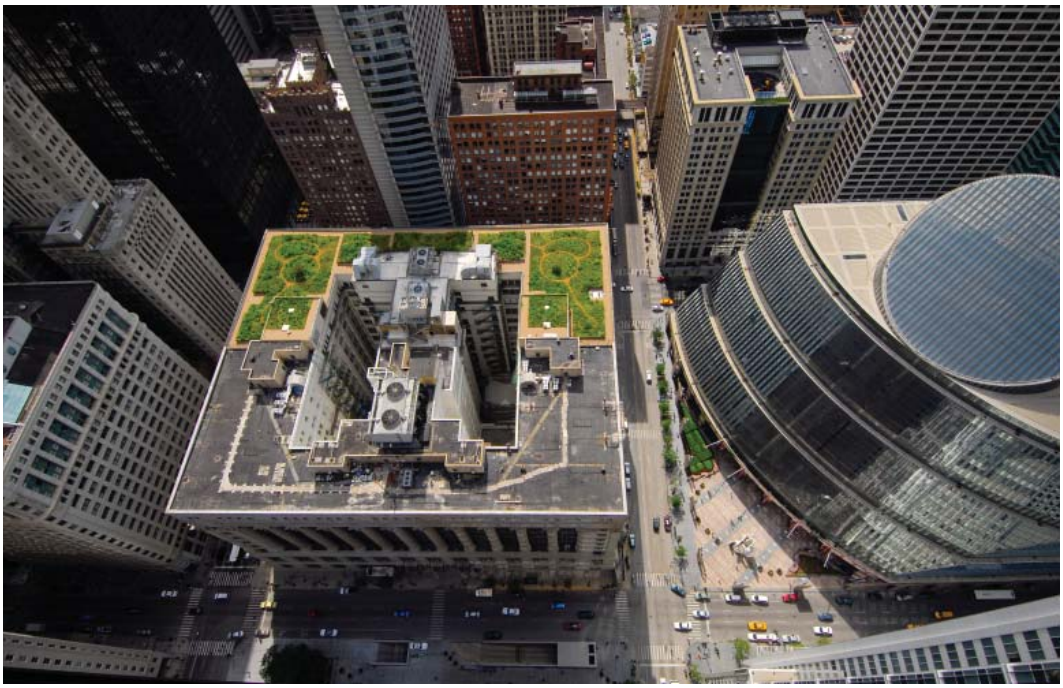


Figure 5: Average additional annual cost in 2007 dollars by climate driver and period

Though heat is the greatest driver, changes in precipitation can also create large impacts. Both positive and negative effects are seen as a result of a projected increase in precipitation through the mid-century and a decrease toward the end of the century. Combined, these impacts would yield a moderate net additional cost impact. (The snow/rain ratio plays strongly in the effects.) While the overall net impact of precipitation is relatively small, the effect of shifting costs could become significant over time and should be further analyzed by individual impact areas when considering specific risk manage-



The Oliver Wyman model indicated that the bulk of economic impacts stem from energy and maintenance costs. Green roofs such as the one on City Hall are aimed at conserving energy.

ment strategies. It is also important to note that the impact of increased precipitation may be much greater on individual City residents than on the City at large. This analysis does factor in resident costs, such as basement flooding or increased insurance, which are not borne by the City infrastructure but do impact its residents.

To highlight specific economic impacts, cost/revenue changes were allocated in the Oliver Wyman model by type (i.e. energy, maintenance, local government revenue variations, capital investments and labor). The model indicated that the bulk of economic impacts stem from energy and maintenance costs; significantly, annual energy costs were nearly 14 times higher in the high emissions scenario than in the low scenario. Given this disparity, it is logical to deduce that adaptation efforts related to energy efficiency and climate-adjusted maintenance programs could provide substantially more effective cost management results than many other potential options.

This analysis was executed and documented in detail for each of the 18 City departments, yielding directional information regarding necessary planning and financial considerations tied to climatic changes. The departmental analyses were aggregated at the city level to produce comprehensive projections for the broader city planning, infrastructure, capital investment and, in some cases, revenue picture.

The study includes abundant detailed analysis and results for the 18 City departments. It is important to reiterate, however, that the study focused only on areas under direct City control. This phase of the analysis does not include non-City business concerns or specific resident costs. These are important considerations which at some point may be included in the model.

In summary, after detailed analysis and evaluation, it appears there is a compelling economic advantage for the City in pursuing mitigation activities that could lead to a

low emission scenario, both regionally and globally. There exists a large differential in all cases relative to the high and low scenarios, both from discrete and cumulative cost factors. This is partially a result of additional capital investments necessary once climate thresholds are reached and then the additional cost of maintaining the expanded infrastructure. One example is how the increased number of extreme heat days requires additional cooling capacity. With additional capacity comes a stepwise function of energy costs to support the new cooling capabilities. (This economic evaluation did not incorporate efficiency improvements in new technologies, which could reduce the high emissions cost rate increase; however, even with efficiency gains, additional capital improvements would still create a cost differential.)

We believe the City may effectively lessen the local economic impact of climate change by concentrating its efforts on reducing energy usage and increasing heat resiliency. As energy usage represents a relatively large proportion of economic impacts, increases in efficiency, lower usage rates or enhanced cost management would yield great benefits. Additionally, as heat is also a large component of economic impacts, decreases in actual heat absorption and improved heat resiliency may significantly decrease the negative impacts from this driver.

As with all complex and “yet to be seen” changes, the economic impacts of climate change on the City of Chicago will not be solved by a single point solution set. However, it is hoped that the increased understanding of the issues and their potential effects outlined in this study will serve to better position the City of Chicago for success in adapting to the coming changes in its environment.