

The Economic Impact of Climate Action Priorities For the City of Hamilton

**Submitted to
Hamilton Public Health Services
City of Hamilton**

**Submitted by
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Introduction

The Earth's climate is warming and this trend has accelerated during the last few decades (IPCC 2007). Climate change is influencing the environment and weather patterns of our planet. There has been an increase in the frequency and severity of extreme weather events, such as floods, thunderstorms, ice storms, droughts and heat waves in various regions of the world (IPCC 2012). These changes have direct and indirect impacts on the infrastructure, air and water quality, economy, social well-being and the health of communities (WHO, 2012; Berry et al., 2014). Many communities have never experienced such conditions in the past and they are vulnerable to climate change impacts. Vulnerability of communities or populations is a function of their exposure to climate change and extreme weather related hazards, their sensitivity to these impacts and their ability to adapt and take protective measures to alleviate these impacts (WHO, 2012).

The City of Hamilton has initiated the development of a Community Climate Change Action Plan outlining how the City and community will respond to future climate changes and what actions can be taken to reduce Greenhouse Gas (GHG) emissions to minimize its ecological footprint and enhance adaptive capabilities of individuals and the community as a whole. In this regard, the City of Hamilton's Community Climate Change Action Plan focuses on nine major community themes as listed below.

Agriculture & Food	Awareness & Education	Energy
Infrastructure	Land Use, Buildings & Build Form	Local Economy & Business
People & Health	Transportation / Mobility	Water & Natural Ecosystems

The City of Hamilton with the community has also envisioned a suite of 10 Climate Action Priorities (CAPs) to be undertaken by the community in near the future. Quantifying the

economic and environmental impacts of these priority actions is necessary for their approval and effective implementation. This study is focused on quantifying the likely socioeconomic and environmental impacts of these priority actions. A list of these priority actions is given in Table 1.

Table 1
Hamilton's Climate Priority Actions

Expanding Local Food Production	CAP #1
Establish Ongoing Education and Awareness Program	CAP #2
Develop a Community Energy Plan to Guide the Hamilton Community's energy future	CAP #3
Revise and Update Municipal Infrastructure Guidelines to Prioritize Low Impact Development	CAP #4
Establish Water Charges to Reflect Real Costs of Water and Wastewater	CAP #5
Create an Accessible Tool Kit for Business to Assist with Impact Analysis and Business Continuity Planning	CAP #6
Conduct a Local Community Vulnerability Assessment of Public Health Impacts from Climate Change	CAP #7
Expand Public Transit Services to Include Dedicated Rapid Transit Lanes Where Possible	CAP #8
Expand Green Spaces	CAP #9
Establish an Ongoing Oversight and Coordination Body to Guide Implementation of the Hamilton Climate Change Action Plan and Report Back on its Progress and Success	CAP#10

Although the CAPs outlined above are primarily focused on mitigation of Greenhouse Gas (GHG) emissions and developing the community's resiliency and adaptation capabilities, many of these actions will have numerous secondary benefits in terms of improving quality of life, positive effects on the local economy and preparing the community for the unexpected outcomes of climate change (adaptation). Some of these secondary benefits include but are not limited to:

- Improved air quality through reduced single occupancy vehicles and increased transit ridership;
- Increased public education, raising awareness and coordination of activities focusing on climate change mitigation and adaptation;
- Promoting low intensity development
- Adopting full cost water charges that reflect the true price of water and its scarcity and full cost development charges that reflect the real cost of development;

- Expanding green spaces and local food production;
- Saving energy and adopting green and renewable energy sources;
- Improving the quality of the environment and promoting better health for all community members.

The main premise of this report is that the main contributor to climate change is the continuous increase of GHG emissions into the atmosphere. Hamilton community has been successful in significantly reducing its GHG emissions in the past decade. Actually, community emissions in Hamilton have been reduced by 29% from 2006 levels in 2012. In those short six years, the annual emissions were reduced from an estimated 23,351,712 tonnes to 16,500,000 tonnes of CO₂. Hamilton has set a 2020 reduction target at 20% from the 2006 level, and has even set its plans to reach longer-term targets of 50% reduction by 2030 and 80% by 2050.

Hamilton's Community Emissions Targets

20% reduction in GHG emissions from 2006 levels by 2020

50% reduction in GHG emissions from 2006 levels by 2030

80% reduction in GHG emissions from 2006 levels by 2050

The environment and economy linkages are at the heart of this analysis. Environmental benefits will be complemented by economic benefits. The issue is not the environment or the economy, rather the two together or neither. The main purpose of this study is again to quantify the economic and environmental impacts of ten priority actions being recommended by the City of Hamilton's Climate Action Plan.

Methodology and Approach

The approach used in this analysis is based on a hybrid integration of (i) input-output analysis; (ii) location theory; and, (iii) relevant segments of typical macroeconomic models. The analysis uses standard economic impact methodology.

A dollar spent on a local program such as on expansion of local food production or on renewable energy circulates and re-circulates within the economy, multiplying the effects of the original expenditures on overall economic activity. This process is referred to as the economic multiplier effect. It operates at several levels:

- The initial expenditures of the program on wages and materials are generally referred to as the direct costs of operation and their effects are referred to as the initial (direct)

effects.

- Subsequent purchases by suppliers of materials and services to sustain the original and derivative expenditures are called the indirect effects.
- The induced effects emerge when workers in the sectors stimulated by initial and indirect expenditures spend their additional income on consumer goods and services in the area.

The impact model used is a special and proprietary application of a unique regional impact model (RIM: Canada) developed by Econometric Research Limited (ERL). It is a unique model in that it captures the economic impact of different activities at the local, provincial and national levels. The local impacts are a special feature of the ERL model that few other systems can implement. The model is a specialized application based on a technology that integrates input-output analysis and location theory that has been applied to the study of the economic impact of several food processing and agricultural activities in Canada and abroad.¹

The model utilizes a large set of economic and technical databases for local communities, provinces and Canada that are regularly published by Statistics Canada. A short list includes the inter-provincial input-output tables, employment by sector, taxes by type of tax and the level of government collecting it, prices of products, energy used in physical and energy units, and location quotients.

The expected impacts are estimated in terms of (i) Ontario Gross Domestic Product (GDP) and the local economy (value added or income) (ii) total gross output (sales); (iii) wages and salaries; (iv) employment; (v) taxes by level of government and in terms of five major tax categories; and (vi) imports. The output and employment impacts are allocated over the standard thirty three sectors of Statistics Canada's Input-Output model for the Ontario economy.

Some of the key impact indicators generated by these models are defined below to assist the reader in interpreting the results of the economic impact analysis:

Initial Expenditures – This figure indicates the amount of expenditures directly made by a given activity in a given sector. It is these expenditures that typically drive the results.

Value Added (GDP) – This figure represents net output generated by the initial expenditures in the province. It is typically the sum of wages, rent, interest and profits in addition to indirect business taxes and depreciation minus subsidies.

Employment – This refers to the total person years (full-time equivalent jobs) generated by the activity expenditures.

¹Sample projects where ERL's Economic Impact Analysis Model was employed include: Economic Contribution of the Ontario Farm Sector and Economic Impact of a Reduction in Farm Income prepared for the Ontario Federation of Agriculture; the Economic Impact of Tourism in Ontario and Regions; Economic Impact of the Toronto Convention Centre, Economic Impact of Capital Projects in Ontario.

Taxes – Our impact system generates a large number of taxes (income taxes, HST, liquor and tobacco taxes, and others) each of which is linked with the level of government receiving it. For example, the Federal government receives the proceeds from the Harmonized Sales Tax (HST), the Provincial government receives the tobacco and liquor taxes and a portion of the HST, and the local governments receive the property and business tax.

Imports – These represent the goods and services acquired from outside the province to sustain the activities of the facilities. They essentially represent leakages from the province.

Multipliers – These are summary measures that represent the division of the total impacts (direct, indirect and induced) by the initial expenditures. For example, the income multiplier associated with the total operational expenditures of a farm is calculated by dividing the total income (value added) impact by the initial operating expenditures. The only exception is that of the employment multiplier where total employment is divided by direct employment in order to preserve the common units.

Impacts

The impact results are driven by the inputs defined by the climate mitigation and/or adaptation action plan. These inputs include both capital outlays and operational and maintenance expenditures. A suite of assumptions are made to generate the required inputs to implement the specific climate action priority that the RIM system processes. These inputs vary by program but typically involve expenditures on machinery, construction, energy use and labour or represent avoided costs that are re-spent by the relevant sector. These inputs were prepared by ERL with significant help from the City and by using the many studies the City has commissioned. These will be identified as used.

The results that will follow are based on detailed calculations and large spreadsheets that reflect the assumptions and sources of data. They are available from the City and the Consultant upon request.

Once the inputs are defined and validated, the RIM system is used to generate a large set of impact results that are presented at both the local level (Hamilton) and the provincial (Ontario) level. Standard tables and figures are used to display the results and they are summarised in a few statements that capture the most salient results below the tables for each initiative. All impacts are annualized. In this way the impact results represent a scalable number for as many years a Climate Action Priorities remains in effect.

Three types of impacts are generated. First, we estimate the economic impacts of capital expenditures. Second, the operational expenditures' impacts are then estimated. Third, if the program generates energy savings and other avoided costs these are filtered back to the sector (residential, institutional, commercial or industrial) realizing the savings. These savings are assumed to be re-spent. The residential sector re-spends its savings on consumption in the same

typical way the input-output defines this pattern. On the other hand, the business sector, when relevant, is assumed to re-spend its savings on investment and again in the same pattern defined in the input-output structure.

Not all of the benefits generated by the CAPs can be quantified and it is extremely difficult to identify and capture all of the benefits. Most of the estimates rest on a number of assumptions that were necessary to facilitate the quantifications. We make these assumptions explicit for each and every CAP.

In what follows, we present the assumptions, the calculated inputs and the impact results of each Climate Action Priorities in the order listed in Table 1.

Expanding Local Food Production - CAP #1

One unmistakable feature of the food system is that Ontarians consume more food than the province produces, resulting in food imports that approach \$20 billion per year. Over 50% of the \$20 billion in imported food products can be produced in Ontario. For example, if Ontario production expanded to replace 10% of the top 10 fruit and vegetable imports, the Ontario economy could benefit by nearly an additional quarter of a billion dollars in Gross Domestic Product (GDP) and 3,400 more full-time jobs (FTE). As well, with fewer imports, transportation requirements to ship food from out-of-province supply sources also decrease, reducing the environmental impact of the food system.²

Agriculture and food systems in Hamilton are not much different and probably more dependent on imports than the province. With the exception of a small number of field crops (Barley and Soy Beans) and a few vegetables (Green and Wax Beans), Hamilton sustains large deficits in many crops, fruits, vegetables and particularly in meat (Tables 2 & 3).

It appears that there is room for the expansion of local food production. The selection of crops, fruits and vegetables, as well as, meat for local production expansion was guided by the Federal Guide Lines for Healthy Living (Table 4), the existence of a local production base and where it is very likely that local farmers would take up the challenge of meeting local consumption.

Assumptions

The selected candidates for expansion of local food production, includes Apples, Potatoes, tomatoes and Strawberries. Two scenarios were constructed –an expansion of local production by 10% and another by 20%. These expansions were compared to existing production and found to represent minor changes, particularly when local production is expanded by 10%. In the case

² Atif Kubursi, Rod MacRae, Harry Cummings and Pavlos Kanaroglou. *DOLLARS & SENSE: The Economic and Environmental Impacts of Food in Southern Ontario*. Metcalf Foundation, the J.W.McConnell Family Foundation and the Friends of the Greenbelt Foundation. 2015.

of Strawberries (1.26%) and Tomatoes (4.66%) but major expansion in the case of Potatoes (24.66%) and an average expansion in the case of Apples (12.38%) (See Table 5).

For the 20% production expansion scenario, the shares in local production rise significantly, particularly in the case of Potatoes. For the rest of the candidate crops the 20% expansion is apparently feasible particularly for Tomatoes and Strawberries.

Chicken production expansion is selected in this analysis because the existing production base in Hamilton is vibrant and the potential for expansion is high. Besides, Chicken production consumes little water and the ratio of value to cost is high.

Table 2
Food Surplus/Deficit, Hamilton, 2011
Field Crops, Fruits and Vegetables

Crop	Marketed Production ('000 tonnes)	Marketed Production kg/capita	Consumption kg/capita	Food Surplus/Deficit kg/capita	Total Food Deficit/Surplus ('000 tonnes)
Flour	10.612	20.41	60.28	-39.87	-20.73
Oats	0.88	1.69	2.12	-0.43	-0.22
Barley	0.85	1.63	0.07	1.56	0.81
Soy Bean Oil	6.944	13.36	5.50	7.86	4.08
	('000) lbs	lbs / capita	lbs / capita	lbs / capita	('000) lbs
Apples	12011.2	23.10	51.70	-28.60	-14870.16
Grapes	5374	10.34	10.36	-0.03	-13.71
Peaches	122	0.23	4.74	-4.51	-2342.56
Strawberries	605.6	1.16	9.99	-8.83	-4588.69
Cabbage	5915	11.38	11.77	-0.39	-204.80
Green & Wax Beans	2366.4	4.55	4.23	0.32	167.02
Potatoes	18875	36.30	125.82	-89.52	-46544.98
Carrots	0	0.00	24.27	-24.27	-12619.16
Sweet Corn	4172.2	8.02	16.84	-8.82	-4583.74
Tomatoes	18278.5	35.15	69.00	-33.85	-17597.98
Peppers	4113	7.91	9.02	-1.11	-576.94
Dry Onions	0	0.00	18.55	-18.55	-9642.97

Source: Statistics Canada: Field Crop Reporting Series; Census of Agriculture 2011

Table 3
Food Surplus/Deficit, Hamilton, 2011
Meat and Eggs

	Count	Production	Production	Consumption	Food Surplus/Deficit	Total Food Deficit/Surplus
Item	number	lbs	lbs/capita	lbs/capita	lb/capita	lbs
Beef	3,753	2,627,146	5.05	63.4	-58.3	-30,316,822
Sheep & Lambs	8,299	622,403	1.20	2.44	-1.2	-646,273
Pigs	15,519	2,234,772	4.30	49.24	-44.9	-23,367,517
Chicken		20,978,233	40.35	72.36	-32.0	-16.6
Turkey		213,434	0.41	10.36	-10.0	-5.2
	Count		Production	Consumption	Food Surplus/Deficit	Total Food Deficit/Surplus
	dozens		dozens/capita	dozens/capita	dozens/capita	dozens
Table Eggs	296,245		0.6	16.1	-15.5	-8,074,934

Source: Statistical Services, OMAFRA and Statistics Canada, Census of Agriculture 2011

Table 4
Current and Optimal Food Surplus/Deficit by County, Ontario, 2011

County	2011 Population	Waste Factor	Production ('000 tonnes)	Production kg/capita	Current Consumption kg/capita	Current Food Surplus/Deficit kg/capita	Total Current Food Deficit/Surplus ('000 tonnes)	Optimal Consumption (including waste) kg/capita*	Total Optimal Consumption ('000 tonnes)	Total Food Deficit/Surplus Using Optimal ('000 tonnes)	Percentage Change (Optimal vs. Current)
Oats	519,949	1.02	0.88	1.69	2.12	-0.43	-0.22	10.30	5.36	-4.48	1936.4%
Cabbage	519,949	1.69	2.69	5.17	5.35	-0.18	-0.09	17.64	9.17	-6.48	7100.0%
Green & Wax Beans	519,949	1.75	1.08	2.07	1.92	0.15	0.08	15.75	8.19	-7.11	-8987.5%
Carrots	519,949	1.69	0.00	0.00	11.03	-11.03	-5.74	38.53	20.03	-20.03	249.0%
Tomatoes	519,949	1.89	8.31	15.98	31.36	-15.38	-8.00	31.19	16.21	-7.91	-1.1%
Strawberries	519,949	1.69	0.28	0.53	4.54	-4.01	-2.09	7.67	3.99	-3.71	77.5%
White Beans	519,949	1.19	0	0.0	4.0	-4.0	-2.1	8.1	4.21	-4.21	102.4%
Apples	519,949	1.64	5.46	10.50	23.50	-13.00	-6.76	34.11	17.74	-12.28	81.7%
Sweet Corn	519,949	4.35	1.90	3.65	7.65	-4.01	-2.08	15.66	8.14	-6.25	200.5%
Potatoes	519,949	1.96	8.58	16.50	57.19	-40.69	-21.16	95.26	49.53	-40.95	93.5%

Source: Statistics Canada: Field Crop Reporting Series; Census of Agriculture 2011

Table 5
Food Surplus/Deficit, Hamilton, 2011
Import Replacement

Selected Commodities	Deficit Reduction (tonnes)	Value	Share in Current Production
Apples 10%	675.92	\$817,859	12.38%
Apples 20%	1351.83	\$1,635,718	24.76%
Potatoes 10%	2115.68	\$2,614,311	24.66%
Potatoes 20%	4231.36	\$5,228,621	49.32%
Tomatoes 10%	399.95	\$687,921	4.66%
Tomatoes 20%	799.91	\$1,375,842	9.32%
Strawberries 10%	104.29	\$271,150	1.26%
Strawberries 20%	208.58	\$542,300	2.51%
Total @ 10%		\$4,391,241	
Total @ 20%		\$8,782,481	

Source: Econometric Research Limited

Economic Impact Results

The economic impact results are displayed in Table 6 and Figure 1.

- Total income of Ontario is increased by about \$47 million, of which \$44 million is generated in Hamilton.
- Wages and salaries are augmented by about \$30.9 million sustaining net direct effective wages of over \$43,165 and a total wage of \$52,618. Hamilton's share is about \$44.6 million.
- Over 842 FTEs of employment are generated by CAP in Ontario, of which 604 FTEs will be in Hamilton.
- A total of over \$10.7 million are collected by the three levels of government on the impacts, with the City of Hamilton governments collecting about \$1.7 million.

Figure 1
Province-Wide Impacts of Local Food Expansion

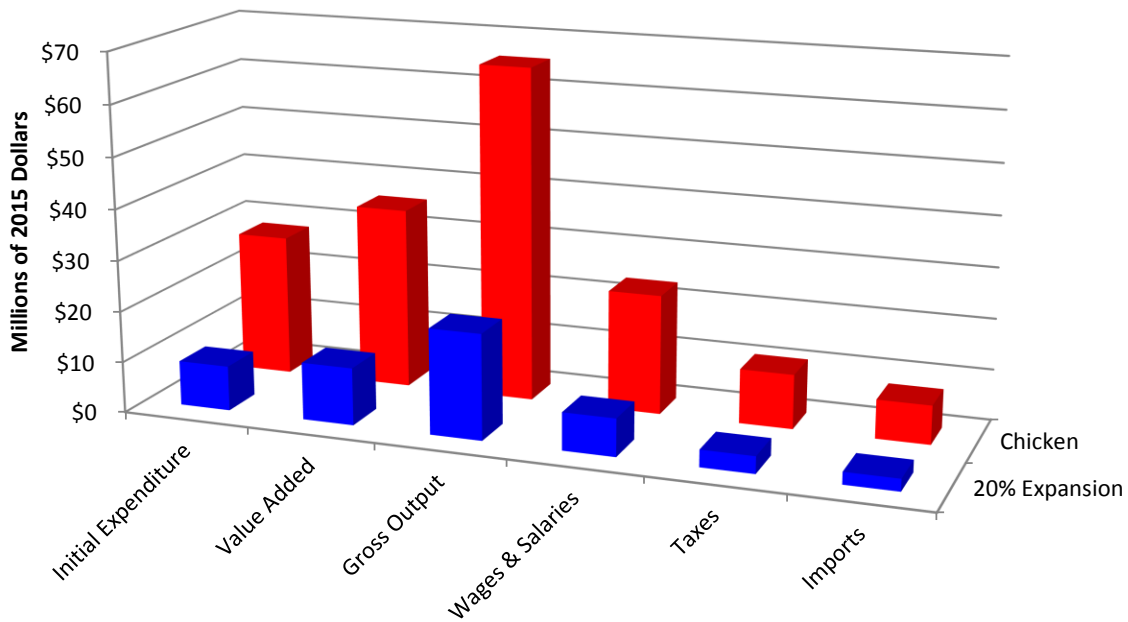


Table 6
Province-Wide Impacts of Local Food Expansion
(Selected Commodities, Thousands of 2015 Dollars)

	Ontario				Hamilton			
	Agriculture	20%	Chicken	Total (2+3)	Agriculture	20%	Chicken	Total (6+7)
Initial Expenditure	\$298,117	\$8,782	\$27,856	\$36,638	\$298,117	\$8,782	\$27,856	\$36,638
Value Added								
Direct	\$187,076	\$5,511	\$17,480	\$22,991	\$177,974	\$5,243	\$16,630	\$21,873
Indirect & Induced	\$194,745	\$5,737	\$18,197	\$23,934	\$184,698	\$5,441	\$17,258	\$22,699
Total	\$381,821	\$11,248	\$35,677	\$46,925	\$362,672	\$10,684	\$33,888	\$44,572
Multiplier	1.28	1.28	1.28	1.28	1.22	1.22	1.22	1.22
Gross Output								
Direct	\$145,634	\$4,290	\$13,608	\$17,898	\$298,117	\$8,782	\$27,856	\$36,638
Indirect & Induced	\$556,309	\$16,389	\$51,981	\$68,370	\$324,256	\$9,553	\$30,298	\$39,851
Total	\$701,943	\$20,679	\$65,589	\$86,268	\$622,373	\$18,335	\$58,154	\$76,489
Multiplier	2.35	2.35	2.35	2.35	2.09	2.09	2.09	2.09
Wages & Salaries								
Direct	\$133,989	\$3,947	\$12,520	\$16,467	\$134,166	\$3,953	\$12,536	\$16,489
Indirect & Induced	\$117,250	\$3,454	\$10,956	\$14,410	\$124,426	\$3,665	\$11,627	\$15,292
Total	\$251,239	\$7,401	\$23,476	\$30,877	\$258,592	\$7,618	\$24,163	\$31,781
Employment								
Direct	4,356	129	407	536	3,105	92	290	382
Indirect & Induced	2,494	73	233	306	1,804	53	169	222
Total	6,850	202	640	842	4,909	145	459	604
Multiplier	1.57	1.57	1.57	1.57	1.58	1.58	1.58	1.58
Taxes								
Federal	\$62,470	\$1,840	\$5,837	\$7,677	\$53,693	\$1,582	\$5,017	\$6,599
Provincial	\$39,935	\$1,176	\$3,732	\$4,908	\$42,474	\$1,251	\$3,969	\$5,220
Local	\$11,933	\$352	\$1,115	\$1,467	\$14,134	\$416	\$1,321	\$1,737
Total	\$114,338	\$3,368	\$10,684	\$14,052	\$110,301	\$3,249	\$10,307	\$13,556
Imports								
From Other Provinces	\$54,176	\$1,596	\$5,062	\$6,658	\$44,655	\$1,316	\$4,173	\$5,489
From Other Countries	\$27,458	\$809	\$2,566	\$3,375	\$23,486	\$692	\$2,195	\$2,887
Total	\$81,634	\$2,405	\$7,628	\$10,033	\$68,141	\$2,008	\$6,368	\$8,376

Source: Econometric Research Limited

Environmental Impact Results

There are many significant environmental benefits due to expansion of local food production. These benefits may be in terms of some reduction in GHGs, savings in water use, improvements in air quality due to reduction of air pollutants and energy savings. Table 7 provides quantitative estimates of the additional environmental impacts of expanding agriculture and chicken production by 20% in Hamilton. Singling out carbon dioxide (CO₂) emissions alone, there will be an increase of 16,072 tonnes in Hamilton. There will be, however, reductions in emissions of CO₂ that would result from avoiding transporting these products from distant locations. These savings will amount to 3,541 tonnes (tables 7 and 23).

Table 7
The Environmental Impacts of Local Food Expansion

	Ontario				Hamilton			
	Agriculture	20%	Chicken	Total (2+3)	Agriculture	20%	Chicken	Total (2+3)
Demand for Water (MCM)								
Intake	201.2	5.93	18.80	24.73	157.3	4.63	14.70	19.33
Discharge	199.0	5.86	18.59	24.45	155.7	4.59	14.55	19.14
Net Usage	2.3	0.07	0.21	0.28	1.6	0.04	0.15	0.19
Air Emissions (Tonnes)								
Particulates	193.1	5.7	18.0	23.7	39.7	1.2	3.7	4.9
Sulphur Oxides	553.0	16.3	51.7	68.0	48.1	1.4	4.5	5.9
Nitrogen Oxide	166.1	4.9	15.5	20.4	48.0	1.4	4.5	5.9
Volatile Organic C	956.0	28.2	89.3	117.5	101.4	3.0	9.5	12.5
Carbon Monoxide	581.6	17.1	54.3	71.5	289.1	8.5	27.0	35.5
Energy Used (terajoules)								
Coal	1,029.4	30.3	96.2	126.5	778.1	22.9	72.7	95.6
Crude Oil	2,699.0	79.5	252.2	331.7	547.5	16.1	51.2	67.3
Natural Gas	1,565.5	46.1	146.3	192.4	1,303.7	38.4	121.8	160.2
Electricity	631.9	18.6	59.0	77.7	537.5	15.8	50.2	66.1
Nuclear Steam	216.2	6.4	20.2	26.6	111.1	3.3	10.4	13.7
Total	6,141.9	181.0	573.9	754.9	3,277.9	96.6	306.3	402.8
Greenhouse Gases (Tonnes)								
Carbon Dioxide	325,927.3	9,601.8	30,454.6	40,056.4	130,775.6	3,852.6	12,219.7	16,072.3
Methane	354.0	10.4	33.1	43.5	161.7	4.8	15.1	19.9
Nitrous Oxide	465.7	13.7	43.5	57.2	219.6	6.5	20.5	27.0
Green GDP ('000 Dollars)								
GDP	\$381,821	\$11,248	\$35,677	\$46,925	\$362,672	\$10,684	\$33,888	\$44,572
Green Cost	\$22,673	\$668	\$2,119	\$2,787	\$7,738	\$228	\$723	\$951
Green GDP	\$359,148	\$10,580	\$33,559	\$44,139	\$354,934	\$10,456	\$33,165	\$43,621
Percent of GDP	94.1%	94.1%	94.1%	94.1%	97.9%	97.9%	97.9%	97.9%

Source: Econometric Research Limited

Establish Ongoing Education and Awareness Program - CAP #2

The role of education and raising peoples' awareness of the potential and real impacts of climate change cannot be exaggerated. Many communities in Ontario and Canada have found it necessary and urgent to put the issues of climate change on the public agenda. There are still groups that feel that the impacts and potential losses and vulnerabilities are exaggerated. A few still deny the occurrence of climate change or the connection of human action to its causes.

There is ample room to debate the climate change issues and educate public about the dangers of inaction and postponement of decisions about mitigation, adaptation and creating resilient communities.

During the development of this CAP, "Let's Talk About the Weather" in-person community conversations were held across Hamilton in both urban and rural areas and in various Wards. Conversations took place in the community at 35 locations including coffee shops, branches of

the Hamilton Public Library, McMaster University, Mohawk College and local events including the Ancaster Agricultural Fair, the Rockton World's Fair, Saturday's at the Creek and James North Art Crawl and at workshops held by community organizations.

More than 200 citizens representing various Wards across Hamilton were engaged at these conversations, workshops and events. Approximately 400 individuals and 91 neighbourhood associations, business and community organizations signed up and were kept informed through notifications, invitations and on-line newsletters.

The City is planning a few activities and actions aimed at maintaining the conversation and engagement with the public on challenges of climate change and related issues. These activities aim to:

- Establish ongoing education and awareness campaign/program building on *Let's Talk About the Weather* to raise awareness and facilitate ongoing dialogue (face-to-face, online, etc.)
- Establish media partnerships to include climate related coverage and linkages to local weather events.
- Explore/develop "gamification" strategy as an educational tool about mitigation and adaptation techniques and processes.
- Host regular events focused on climate change (speaker series, annual event, etc.).
- Engage youth in an ongoing forum on climate action to raise awareness and motivate further actions.
- Host art competition to capture creative interpretations of sustainable living.
- Display artist renderings of positive visions of future sustainable ways to living in public spaces.
- Establish a coordinated knowledge sharing hub or mechanism to further communicate climate related events, activities, initiatives, etc.

Assumptions

The City has earmarked a small budget of \$40,000 to defray part of the cost of maintaining the discussion on climate change issues and broaden the engagement of the public in adaptation and mitigation.

Economic Impact Results

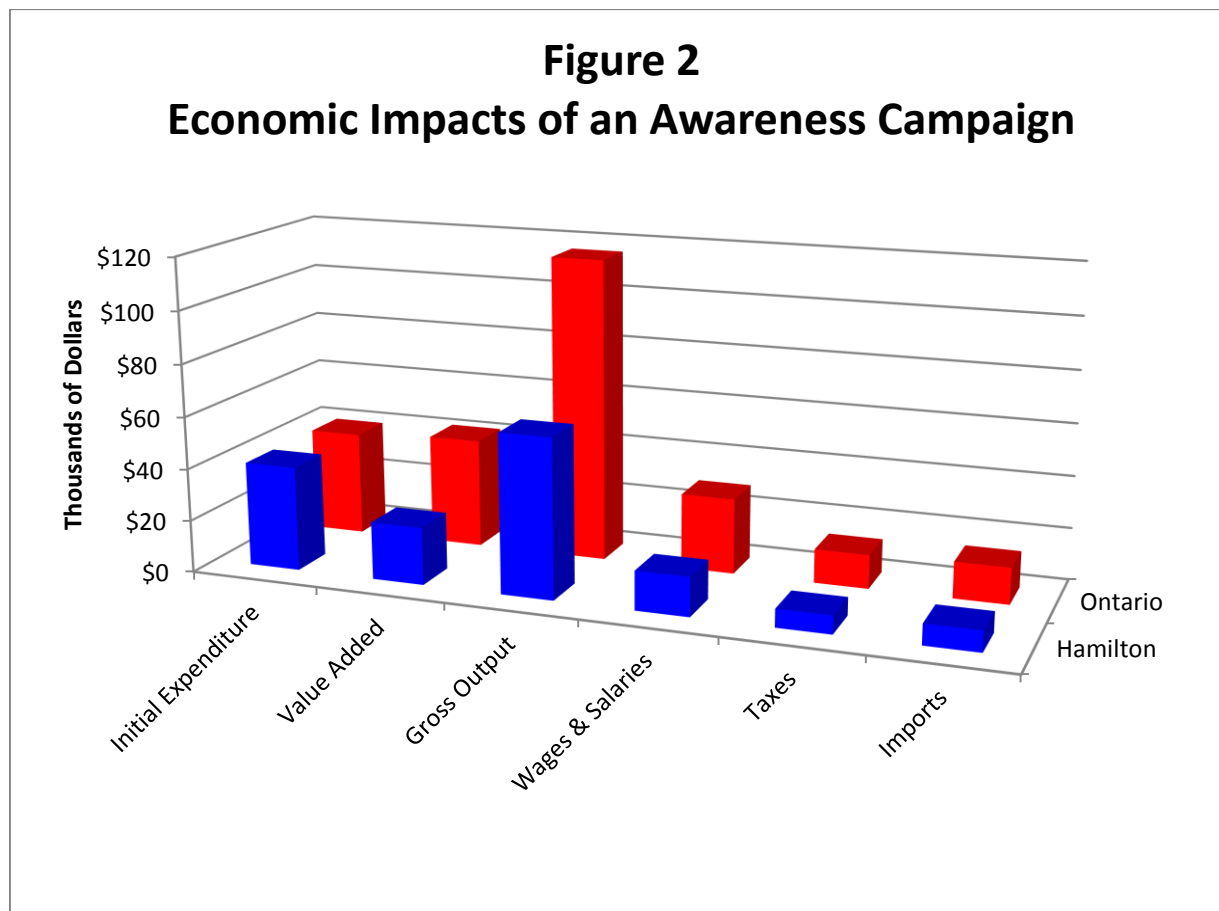
The economic impacts of this expenditure are rather small but not totally insignificant. They include the following (Table 8 and Figure 2):

- Total income of Ontario is increased by about \$42 thousand, of which \$22 thousand will be in Hamilton.
- Wages and salaries are augmented by about \$29 thousand in Ontario of which \$15 thousand will be in Hamilton.
- One half of a FTE job will be sustained in Ontario of which a third of an FTE is in Hamilton.
- A total of over \$13 thousand will be collected by the three levels of government on the impacts with the City of Hamilton collecting about \$1 thousand.

Table 8
Economic Impacts of an Awareness Campaign
 (Thousands of 2015 Dollars)

	Ontario	Hamilton
Initial Expenditure	\$40	\$40
Value Added		
Direct	\$6	\$6
Indirect & Induced	\$36	\$16
Total	\$42	\$22
Multiplier	1.06	0.55
Gross Output		
Direct	\$40	\$40
Indirect & Induced	\$76	\$21
Total	\$116	\$61
Multiplier	2.90	1.51
Wages & Salaries		
Direct	\$4	\$4
Indirect & Induced	\$25	\$11
Total	\$29	\$15
Employment		
Direct	0.1	0.1
Indirect & Induced	0.4	0.2
Total	0.5	0.3
Multiplier	5.00	3.00
Taxes		
Federal	\$6	\$3
Provincial	\$5	\$3
Local	\$2	\$1
Total	\$13	\$7
Imports		
From Other Provinces	\$9	\$5
From Other Countries	\$5	\$3
Total	\$14	\$8

Source: Econometric Research Limited



Environmental Impact Results

The increased economic activity sustained by this CAP is small but still generates emissions and waste. We use the CO₂ amount as a proxy for the environmental impacts by this CAP. These are increased by only 34 tonnes. This amount of CO₂ sets the lower bound on the mitigation that this CAP should aim at to be carbon neutral. This is not difficult to achieve and in all likelihood it would be exceeded.

Develop a Community Energy Plan to Guide the Hamilton Community's Energy Future - CAP #3

Community Energy mapping for the City was undertaken in 2011 and there are a number of energy related initiatives being undertaken locally by the City of Hamilton (with respect to its corporate assets), utilities and local groups to reduce and improve energy conservation. There is no central community plan with targets that has been established. As energy is a key link to climate change in the community and lowering the community's carbon footprint, a plan is

needed to address energy efficiency in the community and to integrate actions towards the reduction of greenhouse gas emissions.

Continued efforts to reduce energy consumed by the various City departments and to mitigate and control their associated costs have already demonstrated success in the following major categories of energy management activities.

- **Utility Rates and Cost Avoidance:** With a strategic plan for mitigating the financial risk associated with the commodity portion of energy costs in current and future energy markets, the City of Hamilton has benefited from costs that are lower than other municipalities. This procurement strategy assists in the creation and control of various energy budgets and yields and avoidance of some costs that would have been incurred if no action was initiated. **The 2014 savings for this category is \$2,705,777.**
- **Cost Recovery:** The City's continuous efforts to monitor and analyze the more than 2000 City of Hamilton utility accounts has led to recovery of costs stemming from corrections or adjustments made to billing errors, billing anomalies and rate correction analysis. **In 2014, this has resulted in \$302,615 of cost recovery for the City.**
- **Energy Conservation and Incentives:** Implementing energy efficient measures or equipment leads to lower energy consumption which in turn results in energy costs being lower than what they would be by not implementing. Many of these projects that involve capital spending are also eligible for financial incentives from various energy programs delivered by Hydro One, Horizon Utilities and Union Gas. **In 2014 the completed projects captured \$2,883,862 in savings.**

The savings represent the benefit of energy efficient upgrades compared to the City not taking any action.

- **The total energy savings and avoided costs for 2014 are \$5,892,255.**
- **The cumulative total for energy savings and avoided costs from 2005 to the end of 2014 amounts to \$38.7 million dollars.**

Assumptions

These savings are assumed to be made annually and would continue as long as the City is focused on realizing these savings. It is also assumed that these avoided costs would be passed to residents who would re-spend them in the general way the Ontario Input Output tables have captured consumption by commodity under final demand.

Economic Impact Results

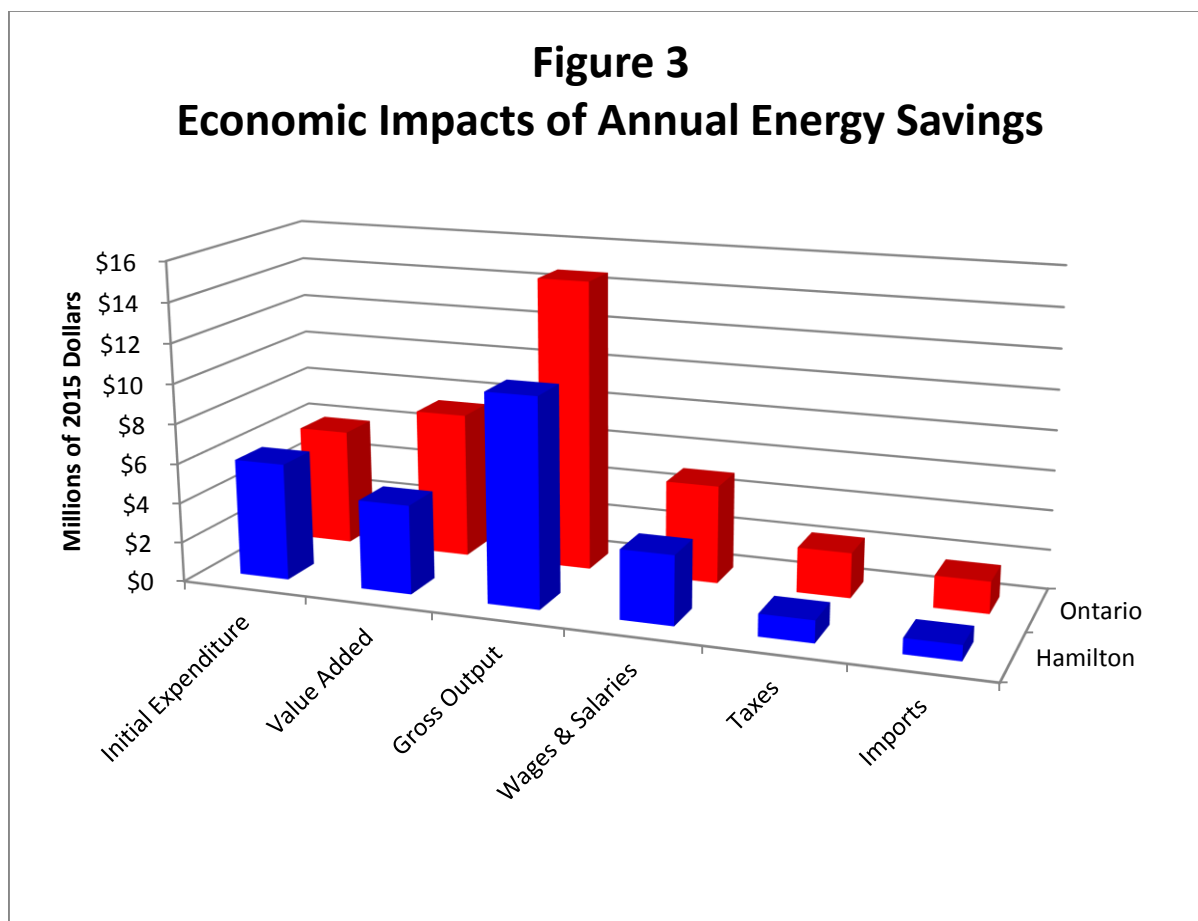
The impact results are displayed in Table 9 and Figure 3 and show the following:

- Total income of Ontario is increased by about \$7.4 million, of which \$4.5 million is in Hamilton.
- Wages and salaries are augmented by about \$4.9 million by CAP #3 sustaining net direct effective wages of over \$82,472 and a total wage of \$77,798. Hamilton's share is about \$3.5 million.
- Over 68 FTEs of employment are generated by CAP #3 in Ontario, of which about 45 FTEs will be in Hamilton.
- A total of over \$2.3 million will be collected by the three levels of government on the impacts with the City of Hamilton collecting about \$142 thousand.

Table 9
Economic Impacts of Annual Energy Savings
Hamilton, Ontario
(Thousands of dollars)

	Ontario	Hamilton
Initial Expenditure	\$5,892	\$5,892
Value Added		
Direct	\$3,478	\$3,255
Indirect & Induced	\$3,881	\$1,223
Total	\$7,359	\$4,478
Multiplier	1.25	0.76
Gross Output		
Direct	\$5,892	\$5,892
Indirect & Induced	\$8,752	\$4,537
Total	\$14,644	\$10,429
Multiplier	2.49	1.77
Wages & Salaries		
Direct	\$2,371	\$2,235
Indirect & Induced	\$2,575	\$1,227
Total	\$4,946	\$3,462
Employment		
Direct	28.8	27.1
Indirect & Induced	39.6	17.4
Total	68.4	44.5
Multiplier	2.38	1.64
Taxes		
Federal	\$1,108	\$540
Provincial	\$876	\$427
Local	\$291	\$142
Total	\$2,275	\$1,109
Imports		
From Other Provinces	\$1,038	\$495
From Other Countries	\$571	\$276
Total	\$1,609	\$771

Source: Econometric Research Limited



Environmental Impact Results

The energy efficiency savings of this CAP are large. When the avoided costs are re-spent they generate positive economic impacts but also a large stream of environmental negatives. The CO₂ generated by these re-spent impacts is over 5,467 tonnes. The production of energy where the efficiency measures would not be realized could have produced 8,585 tonnes of CO₂ for a net savings of 3,118 tonnes.

Revise and Update Municipal Infrastructure Guidelines to Prioritize Low Impact Development - CAP #4

Extreme weather events and more frequent and intense storm activity in Ontario, as a result of climate change, are placing increasing stresses on an already aging private and public infrastructure. A widely recognized potential adverse impact associated with a changing climate in Ontario is increased frequency and duration of extreme weather events. These extreme weather events are anticipated to bring increased precipitation amounts that can potentially lead

to an increased risk of flooding, and an increased risk of suffering losses and/or damages to public and private property as a result.

Encouraging Low Impact Development and designing built areas with absorbent green spaces and permeable hard surfaces can reduce the risks associated with extreme weather events. This is because Low Impact Development seeks to replicate portions of the natural hydrologic cycle that have been compromised in urban areas by fostering natural interception, infiltration, groundwater recharge, and base flow maintenance.

The City of Hamilton Public Works Department in partnership with Planning and Economic Development, the Building Division and the Hamilton Conservation Authority will work to examine and develop guidelines and tools to implement LID in Hamilton.

We examined the projected development plan and population growth in Hamilton for the year 2031. It is clear that if development proceeds within the current shares of single and multiple intensities, there will be little room to intensify growth in the urban core, commuting distances will rise, pollution would increase and urban sprawl potential will be extensive. Alternatively shifting growth to multiple units not only contributes to cleaner environment but would also save on development charges and would anchor development on lower costs and efficient use of space.

Assumptions

We developed two scenarios about future development. First, we assumed that current proportions of single and multiple units that existed in 2011 would not change in 2031 and the projected increase in population would be allocated to these units favouring single and detached housing. The second scenario involved changing the proportions in 2031 to fit the planned and targeted proportions of high intensity development. If nothing else changes the constant dollar development charges of the second scenario would be considerably lower. These savings were passed to consumers and their impacts were estimated.

Residential high intensity growth forecast for 2031 shows a 54% share for single & semi-detached homes, whereas multiple units would represent a 16% share and apartments would represent a 30% share. These changes in shares represent a major shift in intensity from 2011 shares where single and semi-detached units represented 61%, multiple units 14% and apartments 25% of the total number of residential units (Table 10).

Had the same pattern that existed in 2011 did not change there will be more single and semi-detached homes in 2031 than is forecast. Almost 20 thousand more single and semi-detached units would have developed over the forecast level in 2031 (Table 10). Similarly there will be less multiple units and significantly less apartments.

Given that development charges vary by type of housing, we are able to estimate these savings when the mix of units is closer to the forecast proportion than to those proportions that existed in 2011.

A total of \$184.6 million would be saved in development charges (Table 11). If these were allocated back to consumers they are estimated to sustain major economic impacts. These savings are estimated for 2031 using the fixed proportions of 2011 but the population levels of 2031 and the forecast proportions and the projected population in 2031.

It is not possible to assume these savings would be generated each year and therefore the impacts of these savings pertain to 2031 and should be scaled to the forecast units every year between 2011 and 2031.

Table 10
City of Hamilton
Residential Growth Forecast Summary

	Units	Share
As of 2006:		
Single & Semi-detached units	118,410	61%
Multiple Dwellings	25,095	13%
Apartments	50,155	26%
Others	795	
Total units	194,455	
As of 2011:		
Single & Semi-detached units	124,257	61%
Multiple Dwellings	28,240	14%
Apartments	51,118	25%
Others	795	0%
Total units	204,410	
Projected As of 2021:		
Single & Semi-detached units	136,060	59%
Multiple Dwellings	35,672	16%
Apartments	56,633	25%
Others	795	
Total units	229,160	
Projected As of 2031:		
Single & Semi-detached units	148,481	54%
Multiple Dwellings	45,062	16%
Apartments	81,859	30%
Others	795	
Total units	276,197	

Source: Watson & Associates Economists Ltd., May, 2011

Table 11
Development Charge Savings Arising from Low Intensity Development

	Development Charges	Forecast Units	Forecast Charges ('000)	Units Using 2011 Shares	Forecast Charges ('000)	Difference ('000)
Single & Semi-detached units	\$28,095	148,481	4,171,574	167895	4,717,010	545,436
Multiple Dwellings	\$20,138	45,062	907,459	38158	768,426	-139,033
Apartments	\$17,346	81,859	1,419,926	69070	1,198,088	-221,838
Others		795		1074		
Total units		276,197		276197		184,566

Source: Table 8 and Econometric Research Limited

Economic Impact Results

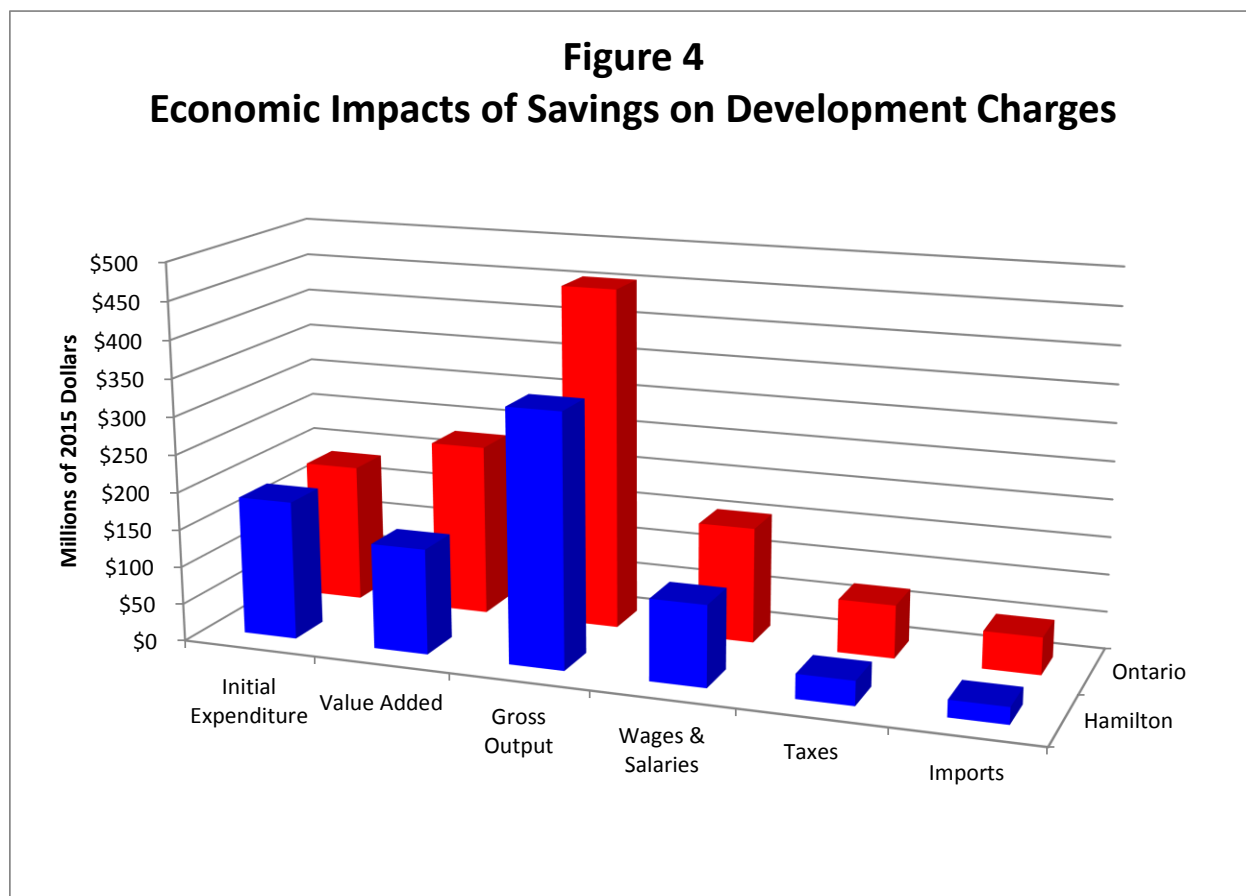
The impact results are displayed in Table 12 and Figure 4 below.

- Total income of Ontario is increased by nearly \$31.3 million, of which \$140.3 million is in Hamilton.
- Wages and salaries are augmented by about \$154 million by this CAP sustaining net direct effective wages of over \$82,817 and a total wage of \$78,336. Hamilton's share is almost \$108 million.
- Over 2,117 FTEs of employment are generated in Ontario, of which 1,376 FTEs will be in Hamilton.
- A total of over \$71 million are collected by the three levels of government on the impacts with the City of Hamilton collecting about \$4.2 million.

Table 12
Economic Impacts of Savings
on Development Charges
Hamilton, Ontario
(Thousands of 2015 Dollars)

	Ontario	Hamilton
Initial Expenditure	\$184,566	\$184,566
Value Added		
Direct	\$108,533	\$101,545
Indirect & Induced	\$120,671	\$38,725
Total	\$229,204	\$140,270
Multiplier	1.24	0.76
Gross Output		
Direct	\$184,566	\$184,566
Indirect & Induced	\$270,091	\$151,344
Total	\$454,657	\$335,910
Multiplier	2.46	1.82
Wages & Salaries		
Direct	\$73,979	\$69,732
Indirect & Induced	\$80,008	\$38,059
Total	\$153,987	\$107,791
Employment		
Direct	894	842
Indirect & Induced	1,223	534
Total	2,117	1,376
Multiplier	2.37	1.63
Taxes		
Federal	\$34,553	\$15,812
Provincial	\$27,358	\$12,512
Local	\$9,104	\$4,163
Total	\$71,015	\$32,487
Imports		
From Other Provinces	\$32,228	\$14,482
From Other Countries	\$17,674	\$8,033
Total	\$49,902	\$22,515

Source: Econometric Research Limited



Environmental Impact Results

The intensification of residential development would see the saving of \$545.4 million on development charges that would have been raised had the development share of single or semi-detached homes remained unchanged from 2011 percentages. The increase in the share of multiple dwellings and apartments in residential development, however, will add to emissions and so will the re-spending of the savings realized on development charges. The gross emissions associated with this CAP are estimated at 11,412 tonnes of CO₂ annually, while the annual savings on not building single and semi-detached houses would be 23692 tonnes of CO₂, for a net reduction of 12,280 tonnes of CO₂ annually associated with this CAP.

Establish Water Charges to Reflect Real Costs of Water and Wastewater – CAP #5

Hamilton's population is expected to grow to 660,000 by 2031. This increase in population and associated increase in land use will result in increasing demand for resources and services, including water. Although development is required to accommodate population growth, there are opportunities to create compact land use patterns that integrate energy and water efficiency to be better prepared for the potential negative impacts of climate change and extreme weather events.

This requires a price structure that communicates better information about relative scarcities of a resource such as water and creates the incentives to economize on its use.

Higher water and waste water charges that reflect not only the cost of production and conveyance but also the opportunity costs of capital and the environmental would encourage more rational use of water and incentive for its conservation to reduce the impacts of a changing climate.

The City of Hamilton through Council, Planning and Economic Development and Public Works will need to lead this action through amendments to water charges and development fees in consultation with the Provincial and Federal governments to bring about charges that reflect the true and full cost of water extraction, conveyance and treatment.

Assumptions

A number of assumptions were made in order to estimate the savings that could be realized on implementing water charges that reflect the true and full economic and environmental costs. These assumptions are displayed in Table 13 below.

For household use, it follows that:

- a 10% increase in water and wastewater charges will lead to a 5% quantity decrease in the average water use to 285 litres per capita per day (this translates into a reduction of 15 litres per day per person).
- a 20% increase in water and wastewater charges will lead to a 10% quantity decrease in the average water use, or to 270 litres per capita per day use (this translates into a reduction of 30 litres per day per person).

For employment, it follows that:

- a 10% increase in water and wastewater charges will lead to a 6% quantity decrease, or to a consumption level of 244.4 litres per employee per day.
- a 20% increase in water and wastewater charges will lead to a 13% quantity decrease, or to a consumption level of 228.8 litres per employee per day

When these savings per day are projected to an annual basis, the following results will emerge:

For a 10% increase in water charges, consumption of water per day would fall from 198,000 m³ to 188,188 m³ for a total savings of 9,900 m³ per day for household demand and employment demand would fall from 78,000 m³ to 73,320 m³ per day, representing a savings of 4,680 m³ per day.

Similarly, for a 20% increase in water charges, consumption of water per day would fall from 198,000 m³ to 178,200 m³ for a total savings of 19,800 m³ per day for household demand. For employment demand, it falls from 78,000 m³ to 68,640 m³ for a total savings of 9,360 m³ per day.

The total monetary value of these savings is \$15.7 million for the 10% water charge increase, and \$34.4 million for the 20% water charge increase.

Table 13
Water and Wastewater Consumption Level
at Different Water Rates

Population in 2031	660,000	
employment 2031	300,000	
water consumption households	300	litres per capita per day
water consumption ICI	260	litres per employee per day
water Price structure		
fixed	\$ 0.30	dollars per m3
variable block1	\$ 0.66	dollars per m3
variable block2	\$ 1.32	dollars per m3
wastewater		
fixed	\$ 0.30	dollars per m3
variable block1	\$ 0.71	dollars per m3
variable block2	\$ 1.41	dollars per m3
price elasticity households	-0.5	
price elasticity ICI	-0.6	
block 1 share	25%	
block2 share	75%	
composite price		
fixed	\$ 0.30	dollars per m3
variable	\$ 2.39	dollars per m3
total	\$ 2.69	dollars per m3
10% price increase	\$ 2.96	dollars per m3
20% price increase	\$ 3.23	dollars per m3

Source: KMK Water Design Criteria, Water and Wastewater Master Plan,
City of Hamilton.
H. Allen Klaiber, V. Kerry Smith, Michael Kaminsky, Aaron Strong,
Measuring Price Elasticities for Residential Water Demand with Limited
Information, National Bureau of Economic Research, Working Paper 18293,
2012, <http://www.nber.org/papers/w18293>

Economic Impact Results

The stream of economic impacts sustained by re-spending of the savings from a 10% water and wastewater charge increase are presented in Table 14 and Figure 5, and these include:

- Total income of Ontario is increased by about \$19.6 million, of which about \$12 million is the share of Hamilton.
- Wages and salaries are augmented by about \$13.1 million in the province which sustain net direct effective wages of over \$82,265 and a total wage of \$66,805. Hamilton's share is about \$7.9 million.
- Over 181 FTEs of employment are generated by this Action annually in Ontario, of which 118 FTEs will be in Hamilton.
- A total of over \$6 million are collected by the three levels of government on the impacts with the City of Hamilton collecting about \$355 thousand.

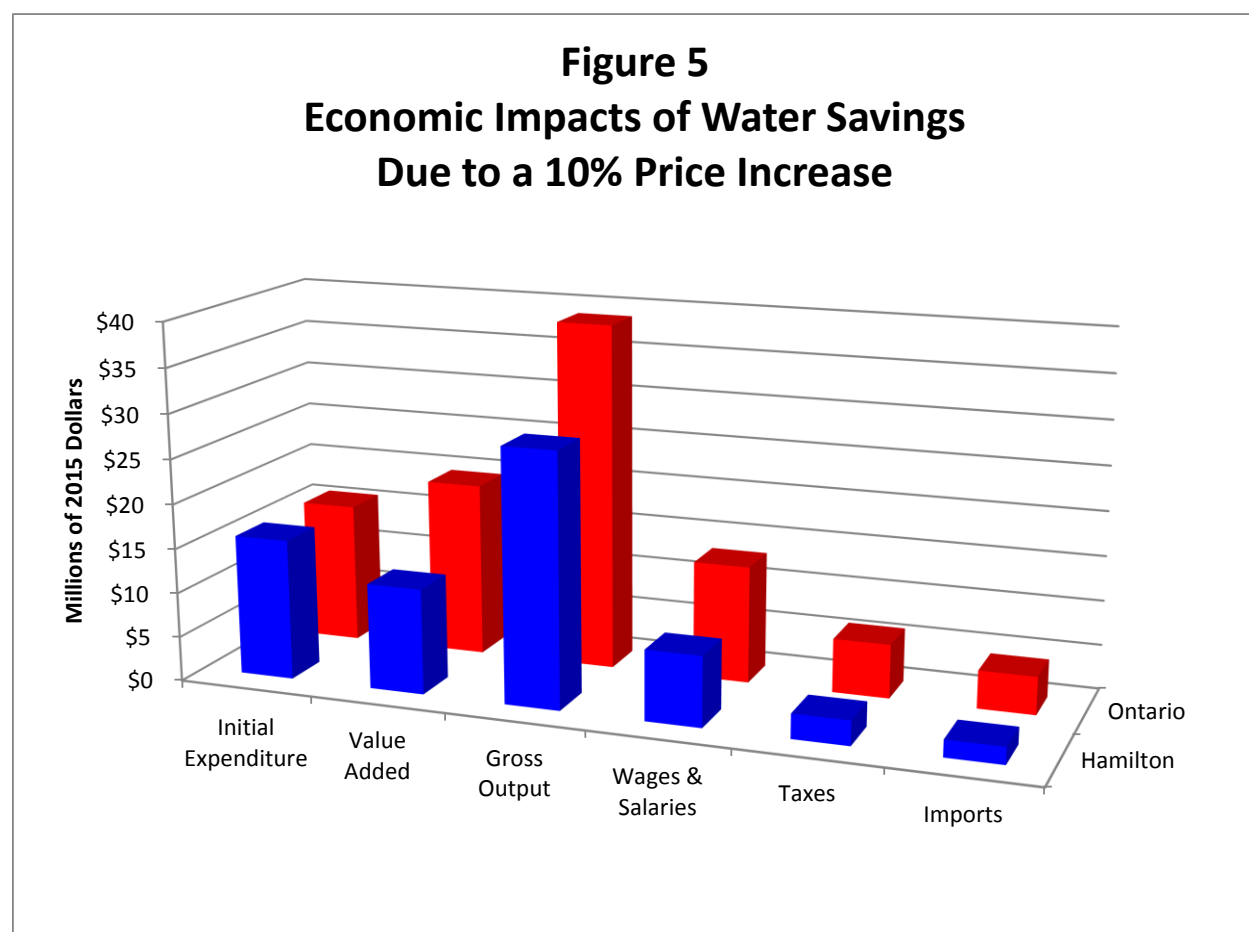


Table 14
Economic Impacts of Water Savings
Due to a 10% Increase in Water Charges
Hamilton, Ontario
(Thousands of 2015 Dollars)

	Ontario	Hamilton
Initial Expenditure	\$15,747	\$15,747
Value Added		
Direct	\$9,260	\$8,664
Indirect & Induced	\$10,295	\$3,146
Total	\$19,555	\$11,810
Multiplier	1.24	0.75
Gross Output		
Direct	\$15,747	\$15,747
Indirect & Induced	\$23,044	\$12,598
Total	\$38,791	\$28,345
Multiplier	2.46	1.80
Wages & Salaries		
Direct	\$6,312	\$5,949
Indirect & Induced	\$6,826	\$1,934
Total	\$13,138	\$7,883
Employment		
Direct	76	72
Indirect & Induced	105	46
Total	181	118
Multiplier	2.38	1.64
Taxes		
Federal	\$2,948	\$1,349
Provincial	\$2,334	\$1,068
Local	\$777	\$355
Total	\$6,059	\$2,772
Imports		
From Other Provinces	\$2,750	\$1,236
From Other Countries	\$1,508	\$685
Total	\$4,258	\$1,921

Source: Econometric Research Limited

The stream of economic impacts sustained by re-spending of the savings from a 20% water and wastewater charge increase is not simply twice of those of the 10%. These are displayed in Table 15 and Figure 6 and they include the following impacts:

- Total income of Ontario is increased by about \$42.7 million, of which about \$25.8 million is the share of Hamilton.
- Wages and salaries are augmented by about \$28.7 million in the province which sustain net direct effective wages of over \$82,665 and a total wage of \$67,184. Hamilton's share is about \$17.2 million.

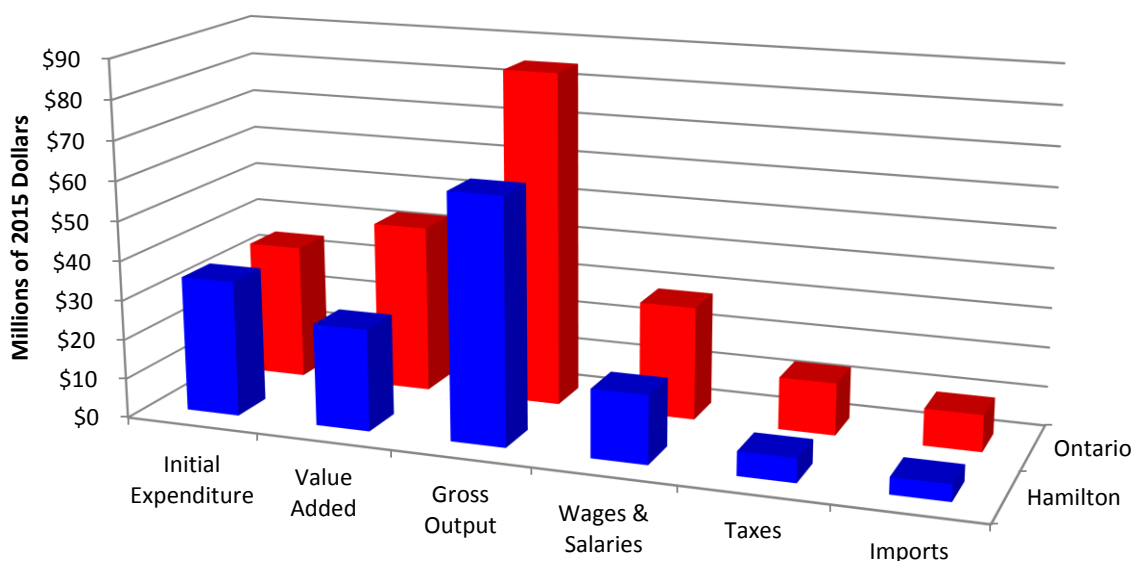
- Over 394 FTEs of employment are generated by this Climate Action Priority on the water savings annually in Ontario, of which 256 FTEs will be in Hamilton.
- A total of over \$13.2 million are collected by the three levels of government on the impacts with the City of Hamilton collecting about \$775 thousand.

Table 15
Economic Impacts of Water Savings
Due to a 20% Increase in Water Charges
Hamilton, Ontario
(Thousands of dollars)

	Ontario	Hamilton
Initial Expenditure	\$34,357	\$34,357
Value Added		
Direct	\$20,203	\$18,902
Indirect & Induced	\$22,463	\$6,866
Total	\$42,666	\$25,768
Multiplier	1.24	0.75
Gross Output		
Direct	\$34,357	\$34,357
Indirect & Induced	\$50,277	\$27,486
Total	\$84,634	\$61,843
Multiplier	2.46	1.80
Wages & Salaries		
Direct	\$13,771	\$12,980
Indirect & Induced	\$14,894	\$4,219
Total	\$28,665	\$17,199
Employment		
Direct	166	157
Indirect & Induced	228	99
Total	394	256
Multiplier	2.37	1.63
Taxes		
Federal	\$6,432	\$2,943
Provincial	\$5,093	\$2,329
Local	\$1,695	\$775
Total	\$13,220	\$6,047
Imports		
From Other Provinces	\$5,999	\$2,696
From Other Countries	\$3,290	\$1,495
Total	\$9,289	\$4,191

Source: Econometric Research Limited

Figure 6
Economic Impacts of Water Savings
Due to a 20% Price Increase



Environmental Impact Results

The expenditure of savings on water use when water and wastewater charges are increased by 10% will generate an additional 14,606 tonnes of CO₂. However, the reductions in water use and treatment will save 8,336 tonnes of CO₂ for a net increase of 6,270 tonnes.

Create an Accessible Tool Kit for Business to Assist with Impact Analysis and Business Continuity Planning - CAP #6

Climate change and extreme weather events are impacting all industries directly or indirectly within Hamilton and Ontario resulting in damages or costs due to weather events, increased regulations and stringent requirements for compliance and legal liability related costs. Climate change presents both reduction and adaptation challenges to local business requiring reduced emissions to prevent further changes and adaptation to existing, unavoidable changes to climate. Reduction of emissions has been the focal point for business efficiency, however as extreme

weather events continue to increase more focus for business is shifting towards business continuity in the face of the risks of climate impacts.

The development of a toolkit for business that could help evaluate climate change mitigation, impact analysis and continuity planning would be useful to trace and estimate the likely consequences of extreme weather events and the best and most efficient way for businesses in the City of Hamilton to mitigate and adapt to climate change.

Assumptions

- The project expenditures are put at \$250 thousand to design, develop, upload and train users.

Economic Impact Results

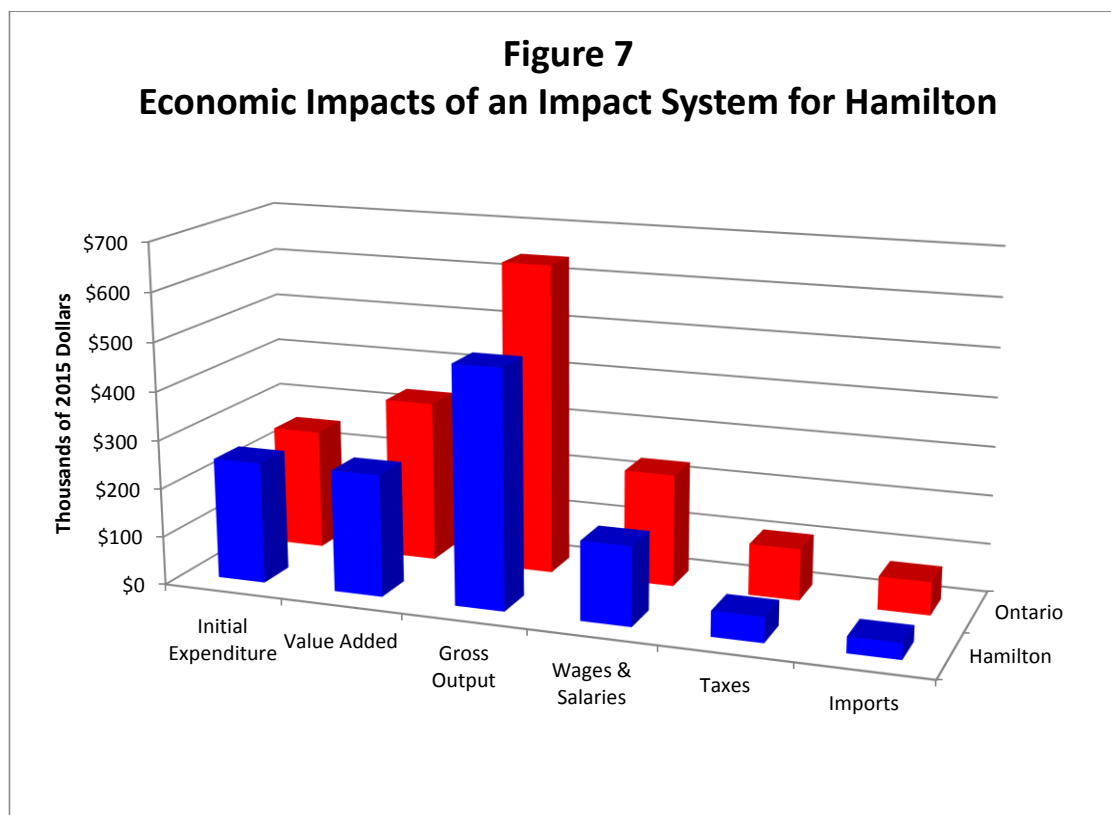
The economic impacts that flow from this expenditure on developing and implementing the impact tool are presented in Table 16 and Figure 7 and include the following:

- Total income of Ontario is increased by about \$334 thousand, of which \$251 thousand is in Hamilton.
- Wages and salaries are augmented by about \$232 thousand by developing the tool which sustains net direct effective wages of over \$82,857 and a total wage of \$77,143. Hamilton's share is about \$162 thousand.
- About 3.2 person years of employment are generated by this Action in Ontario, of which 2.1 person years will be in Hamilton.
- A total of over \$106 thousand will be collected by the three levels of government in Ontario on these impacts, while the City of Hamilton can expect to collect about \$7 thousand.

Table 16
Economic Impacts of an Impact System for Hamilton
(Thousands of Dollars)

	Ontario	Hamilton
Initial Expenditure	\$250	\$250
Value Added		
Direct	\$163	\$160
Indirect & Induced	\$171	\$91
Total	\$334	\$251
Multiplier	1.34	1.00
Gross Output		
Direct	\$250	\$250
Indirect & Induced	\$389	\$238
Total	\$639	\$488
Multiplier	2.56	1.95
Wages & Salaries		
Direct	\$116	\$115
Indirect & Induced	\$116	\$47
Total	\$232	\$162
Employment		
Direct	1.4	1.4
Indirect & Induced	1.8	0.7
Total	3.2	2.1
Multiplier	2.29	1.14
Taxes		
Federal	\$51	\$25
Provincial	\$41	\$20
Local	\$14	\$7
Total	\$106	\$52
Imports		
From Other Provinces	\$43	\$21
From Other Countries	\$25	\$12
Total	\$68	\$33

Source: Econometric Research Limited



Environmental Impact Results

The increased economic activity sustained by this CAP is not large and generates very small quantities of emissions and waste. Again we use the CO₂ amount as a proxy for the environmental impacts by this CAP. These are increased by only 14 tonnes of CO₂. This amount of CO₂ sets the lower bound on the mitigation that this CAP should aim at to be carbon neutral. This is not difficult to achieve and again in all likelihood it would be exceeded.

Conduct a Local Community Vulnerability Assessment of Public Health Impacts from Climate Change- CAP #7

Climate change has many direct and indirect impacts on the health of communities and individuals (Berry et al, 2014; Costello et al., 2009; Seguin 2008; WHO, 2008, 2012; Jerrett et. al., 2012). Warmer temperatures, higher humidity, more frequent extreme weather events such as heatwaves, droughts and precipitation and flooding, changes in air quality and ozone levels, and water-, food-, vector- and rodent-borne diseases may affect individuals and the vulnerable and at-risk populations in the community (Berry et al., 2014).

Although Hamilton delivers a number of initiatives that inform and aim to protect the health of the community such as heat alerts, cold alerts, smog alerts, flood and emergency preparedness, West Nile, and beach inspection, a comprehensive vulnerability scan is a useful exercise to identify gaps and where programs to protect the health of citizens and communities may need to evolve in light of a changing climate and related future impacts.

Here we provide an overview of climate changes and major events and threats that should and could be monitored to devise a general preparedness plan to protect and safeguard the health of the community under adverse weather events and eventualities.

In Canada temperatures have warmed by more than 1.3°C between 1948 and 2007 which is about twice the global average increase in temperature over the same period. There has also been about a 12 percent increase in average precipitation in Canada over the past 50 years (McBean 2012). Intergovernmental Panel on Climate Change (IPCC) emission scenarios suggest that over the next two decades a global warming rate of about 0.2°C per decade is projected regardless of the adopted emission scenario, due to the slow response of the climate system (Bruce 2011). Even for the IPCC's A2 emission scenario which considers slow and regionally oriented economic development, global warming is projected to be 1.5°C in 2050 and 3.8°C in 2100 (IPCC 2007).

There are many ways in which climate change can potentially affect human health:

- **Direct health impacts** may include increased illnesses, injuries, and deaths from extreme weather events, or respiratory illnesses caused by changes in air quality.
- **Indirect health impacts** may include illnesses and deaths linked to climate-related changes in ecosystems, living environment, infectious agents, and agricultural production. Changes in climate and weather may impact severity of many diseases such as asthma, heart disease, and salmonellosis in particular in seniors and children. Vulnerable people and communities will likely experience more frequent and severe health problems due to climate change.

Major Health Effects in Hamilton Area

1. Extreme Temperatures (Heat and Cold Alerts)

Climate change is expected to increase the frequency of extreme heat events in many communities in Canada (Lemmen et al., 2008; Health Canada, 2011a). Hamilton experienced an average of 12 hot days ($T_a > 30^\circ\text{C}$) per year during the 1961 - 1990 period. The number of days with temperatures above 30°C in Hamilton will increase to about 23 and 37 days per year during the period 2021-2040 and 2041 – 2070 (Casati and Yagouti, 2010). Hamilton also experienced severe cold temperatures ($T_a \leq -15^\circ\text{C}$ or -20°C with wind-chill) with cold alerts issued for 27, 34 and 57 days in 2010, 2013 and 2015, respectively. Overall, heat-related mortality associated with warmer temperatures

from climate change will be higher than mortality reductions due to less severe cold weather (Ebi and Mills (2013).

2. Air Quality

Although there is some uncertainty about the degree to which air pollutant levels in Canada are attributed to climate change, recent studies have suggested that climate change is expected to exacerbate health risks associated with poor air quality through increase in heatwaves (Berry et al., 2014), ambient air pollutants (Frumkin et al., 2008), seasonal allergies, pathogens and other biological contaminants (Greer and Fisman, 2008), increase in ground level ozone, O₃ (Environment Canada, 2015,) and changes in ambient air quality due to increasing wildfires (Flannigan et al., 2009). In 2008, the Canadian Medical Association (CMA) estimated 21,000 Canadian deaths attributed to air pollution, which is very significant (CMA, 2008, 2010). Similarly, Health Canada estimated that air pollution causes 5,900 premature deaths each year in eight cities in Canada each year (Seguin, 2008). Some population groups such as children and seniors are particularly susceptible to adverse effects of air pollution, in particular exposure to Nitrogen Dioxide (NO₂), fine Particulate Matter (e.g. PM_{2.5}) and O₃ (Sahsuvargolu et al., 2009; Jerrett et al., 2009; Beckerman et al., 2012).

Over the past decade, there has been some improvement in air quality in many Canadian cities due to changes in local economies and/or implementation of stringent air quality regulations. It suggests that while climate change may negatively affect air quality, the impact can be modulated to some extent through reductions in local air pollutant emissions (Berry et al., 2014). Therefore, some of the costs associated with greenhouse gas mitigation may be offset due to ‘co-benefits’ of better air quality and reduced rates of hospitalization and mortality (Kelly et al., 2012).

Climate change is also expected to impact the incidents of seasonal allergies, through their earlier onsets and increasing the amount of pollen production due to warm and wet conditions (Ziska et al., 2011).

3. Infectious Disease (West Nile Virus and Lyme Disease)

Warmer temperatures and changes in precipitation patterns has altered the distribution and abundance of mosquitoes in Canada, which may increase risk for human vector-borne diseases such as West Nile virus (Hongoh et al., 2012).

From 2000-2005, 1800 cases of West Nile virus were reported causing 46 deaths in Canada (Seguin, 2008). There may be 30% increase in West Nile potential incidents by 2050 in Hamilton (Gough, 2015).

Longer seasonal activity and expanding geographic range of ticks may increase the risk of human exposure to ticks and Lyme disease. Studies suggest that annual incidence of Lyme disease have increased from approximately 30 cases a year to 315 in 2012 and are

Lyme affected areas are spreading into Canada at a rate of 35-55 km per year (Ogden et al., 2008a; Leighton et al., 2012).

4. Water-borne Diseases

Warm temperatures are projected to increase the risk of exposure to waterborne pathogens in drinking and recreational waters that can cause a variety of water-related illnesses (Health Canada, 2012b; Seguin, 2008; Moffatt and Struck, 2011). Surface runoff and flooding associated with heavy precipitation will increase pesticides, nutrients, heavy metals, organic pollutants and pathogen loads originating from urban, agricultural, and wildlife sources and promote blooms of harmful algae in fresh waters (Noyes et al., 2009; Winter et al., 2011). Increase in annual number of diarrhoeal hospitalization among elderly and children due to high temperate and more incidents of waterborne disease incidents are possible.

Poor water quality may also impact recreational activities through increased incidents of beach closures due to E. Coli in some areas (EPA, 2015). Currently most beaches in Hamilton are open for 96-98% of time. Increase in E. Coli and algae may increase beach closure incidents. It depends on remedial measures and investments in beach cleaning. There can be costs associated with these closures as well as more investments to keep them open at normal levels.

5. Food Quality and Supply

In Canada, approximately 4 million episodes of food-borne illness occur every year (Thomas et al., 2013). Most common cases are salmonellosis related illnesses due to higher temperatures and gastrointestinal illness in the summer due to changes in precipitation (Febriani et al., 2010; Ravel et al., 2010).

Climate change may affect certain crop yields due to warm temperatures, while others may benefit from longer growing season in our region. There may be higher incidences of foodborne illnesses. Warm temperature may lead to food damage, spoilage, or contamination, which may limit availability and access to safe food. It may also potentially increase food prices and reduce accessibility for low income or remote isolated communities (Meakin and Kurvits, 2009).

6. Infrastructure Failure Related Impacts

Climate change may increase exposure to health hazards associated with projected increases in the frequency and/or intensity of extreme weather events such as extreme precipitation, flooding, thunderstorms, snow and freezing rain storms, tornadoes and high winds and wildfire (IPCC, 2012). For example, Cheng et al. (2011) project that the number of days with freezing rain will increase in Ontario by 35% to 100% in 2046-2065, and by 35% to 155% in 2081-2100 period.

Cheng et al. (2011) also suggested that flooding due to heavy rainfall in Southern Ontario is expected to increase by 10 to 35% in the period 2046-2065, and by 35 to 50% in the period 2081-2100. Increases in extreme weather events will increase the risk of failure or damage to drinking water, wastewater, and storm-water infrastructures. A breakdown in water infrastructure would contribute to increased risk of exposure to water-related pathogens, chemicals, and algal toxins. It will cause more incidents of death, injury, or illness. Damage to essential infrastructure is also possible such as communication systems, transportation, power systems and disruption of Health Services and damages to hospital and other Health facilities that are required to safeguard human health (Berry, 2014).

Assumptions

The list of assumptions used to quantify the economic impacts of a representative example is presented in Table 17. The focus here is on air quality and related hospitalization rates and their costs.

Table 17
Health Costs Due to Poor Air Quality

35,540,400	Population of Canada in 2014
\$2,200,000,000	Total cost of hospitalization due to air quality in Canada in 2014
\$61.90	Per capita cost of hospitalization due to air quality
547,519	Population of Hamilton 2015
\$33,892,185	Total cost of hospitalization due to air quality in Hamilton
660,000	Hamilton population expected in 2031
1.175%	Population implicit growth rate
\$40,854,914	Expected hospitalization costs in 2031
\$37,373,550	Average cost between 2015 and 2031
\$9,343,387	Hospitalization cost savings due to the elimination of 50% of emissions by 2031

The Economic Impact Results

The economic impacts that arise from the annual savings from the reduction of hospitalization due to expected improvements in air quality are presented in Table 18 and Figure 8. These impacts are purely representative of the many improvements in health outcomes, if and when air quality is improved, and may even be exceeded. The selected impact results include the following:

- Total income of Ontario is increased by about \$11.6 million, of which \$7.1 million is in Hamilton.
- Wages and salaries are augmented by about \$7.8 million by the savings on hospitalization rates due to bad air quality, which sustains net direct effective wages of over \$82,854 and a total wage of \$72,715. Hamilton's share is about \$5.5 million.
- Over 107 FTEs of employment are generated by this Action in Ontario, of which about 70 FTEs will be in Hamilton.
- A total of about \$3.6 million will be collected annually by the three levels of government on these impacts, while the City of Hamilton can expect to collect about \$211 thousand annually.

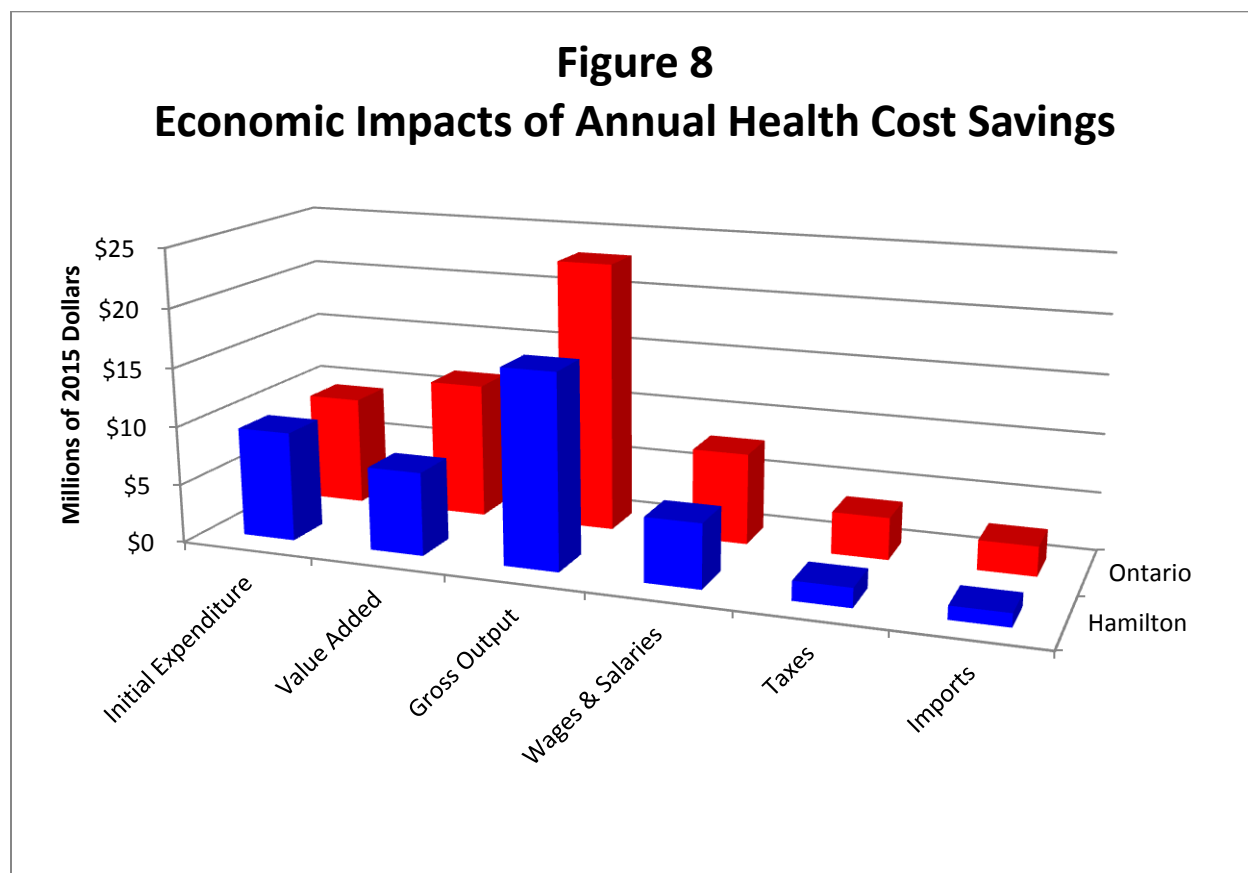


Table 18
Economic Impacts of Annual Health Cost Savings
Hamilton, Ontario
(Thousands of dollars)

	Ontario	Hamilton
Initial Expenditure	\$9,343	\$9,343
Value Added		
Direct	\$5,494	\$5,140
Indirect & Induced	\$6,108	\$1,961
Total	\$11,602	\$7,101
Multiplier	1.24	0.76
Gross Output		
Direct	\$9,343	\$9,343
Indirect & Induced	\$13,672	\$7,194
Total	\$23,015	\$16,537
Multiplier	2.46	1.77
Wages & Salaries		
Direct	\$3,745	\$3,530
Indirect & Induced	\$4,050	\$1,927
Total	\$7,795	\$5,457
Employment		
Direct	45.2	42.6
Indirect & Induced	62.0	27.1
Total	107.2	69.7
Multiplier	2.37	1.64
Taxes		
Federal	\$1,749	\$801
Provincial	\$1,385	\$633
Local	\$461	\$211
Total	\$3,595	\$1,645
Imports		
From Other Provinces	\$1,631	\$733
From Other Countries	\$895	\$407
Total	\$2,526	\$1,140

Source: Econometric Research Limited

Environmental Impact Results

The improvement of air quality in the City of Hamilton as targeted by the City would involve a major reduction of 50% in the emissions by 2030. We have assumed that a commensurate and proportional reduction in all other GHG emissions will be achieved. The annualized savings on health costs that are re-spent would add 8,634 tonnes of CO₂. The annual reductions in health expenditures would save 7,045 tonnes of CO₂. The net impact, not factoring in the major reductions in emissions implicit in this CAP, would be an increase of 1,589 tonnes.

Expand Public Transit Services to Include Dedicated Rapid Transit Lanes Where Possible - CAP #8

Transportation is a leading source of greenhouse gas emissions. It contributes 33% of the total greenhouse gas emissions in Hamilton. On an average day, residents of Hamilton make a total of approximately 1 million trips, or 2.5 trips for every person over 11 years of age. Between 1986 and 2001, local transit declined from handling 12% of morning peak period trips to 6%. Most of this was due to increases in the use of automobiles, which now handle about 85% of daily trips (driver and passenger combined). There is a shift required to encourage more low carbon, low emission transportation choices such as rapid mass transit and fostering alternative forms of transportation for pedestrians and cyclists to reduce greenhouse gas emissions.

Assumptions

The operational assumptions are given in Table 18. We assumed that Hamilton's population has increased to 547,519 persons in 2015 and is expected to increase to 660,000 persons in 2031 as compared to 519,950 in 2011. The share of transit riders is 387,000 km per day in 2015. This is expected to increase to 456,000 km per day in 2031.

The increase in transit ridership is expected to reduce the km travelled per day by car by 518,000 km per day. The savings in cost is the sum of the reduction in travel by car and the cost embedded in the increase in the use of transit. These numbers are displayed in Table 18.

The Economic Impact Results

The economic impact results of this CAP are presented in Table 19 and Figure 9. These results include the following:

- Total income of Ontario is increased by about \$30.8 million, of which \$18.6 million is in Hamilton.
- Wages and salaries are augmented by about \$20.7 million sustaining net direct effective wages of \$82,991 and a total wage of \$72667. Hamilton's share is about \$12.4 million.
- Over 285 FTEs of employment are generated by this climate action in Ontario, of which 185 person years will be in Hamilton.
- A total of about \$9.6 million are collected by the three levels of government on the impacts with the City of Hamilton collecting over \$560 thousand.

Table 18
Transit Economic Benefits and Assumptions

population 2011	519,950
population 2015	547,519
km by car 2015 per day	2,494,000
km by Transit 2015 per day	387,000
population in 2031	660,000
km by car 2031 per day	1,976,000
km by transit 2031 per day	456,000
net increase in transit km per day	69,000
net reduction in km by car per day	518,000
cost per km (1)	\$0.1012
Daily saving to consumers	\$52,404
Annual gross savings	\$19,127,582
Increase in Transit Ridership Cost (2)	\$18,400
Annual transit Cost increase	\$6,716,000
Net annual saving	\$12,411,582
Total car km saved per year	189,070,000
avg km per litre	10
total litres	18,907,000
litres per US gallon	3.787
total US gallons saved	4,992,606.28
CO2 per US gallon (tonnes)	0.00887
Emissions saved	44,284.42
tonnes of CO2 per year	
Fuel Cost Saved	\$12,411,582
Total Costs Saved (3)	\$24,823,163

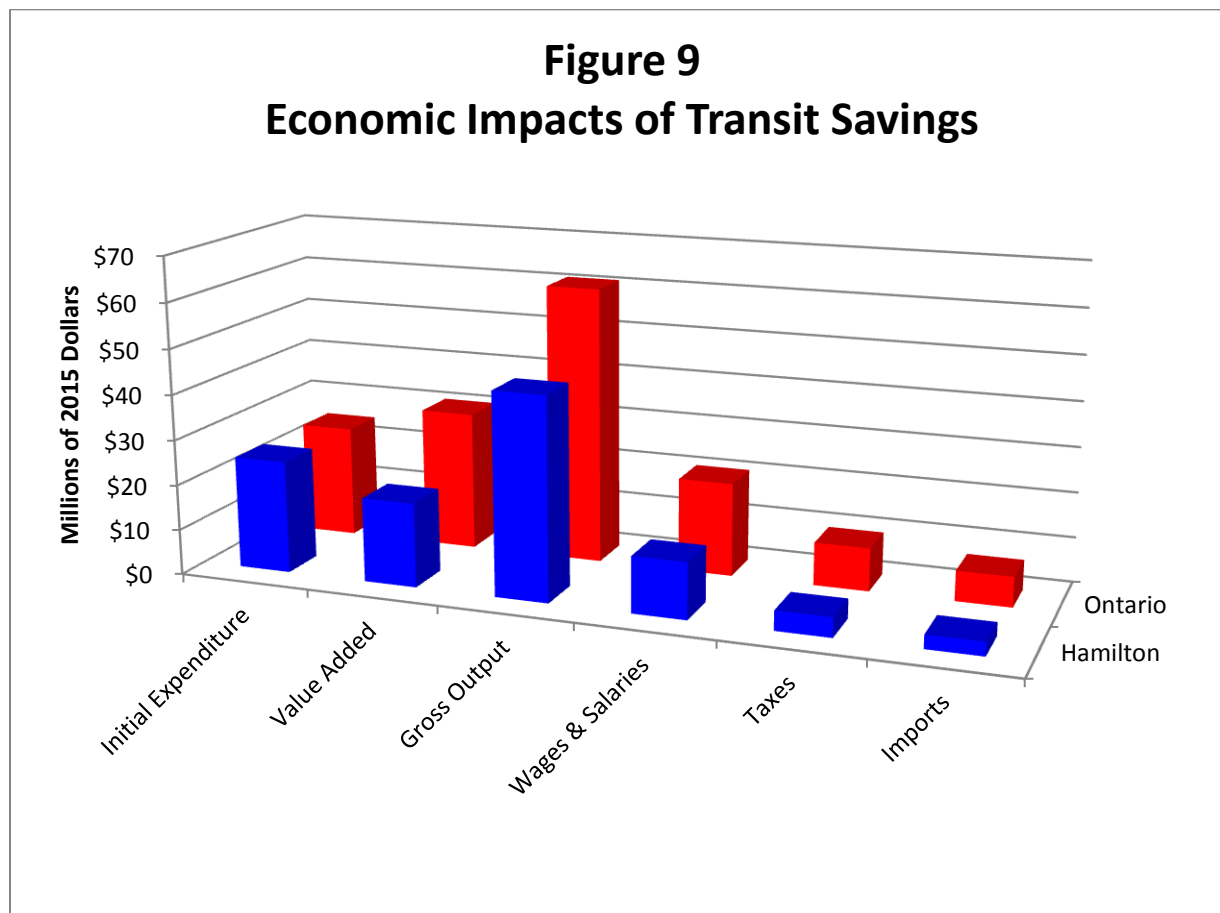
Notes:

- (1) Camary driven on average 18,000km /y and cost of litre is \$1.23
- (2) People travel between 0 and 15 km a day, on average 7.5 km/day, and \$2 per ride
- (3) We assume other costs (insurance, etc) to be another 10 cents per km
Transportation Costs and Benefit Analysis, Table 7, Appendix D, VTPI, 2007, <http://www.vtpi.org/tca>

Table 19
Economic Impacts of Transit Savings
Hamilton, Ontario
(Thousands of dollars)

	Ontario	Hamilton
Initial Expenditure	\$24,823	\$24,823
Value Added		
Direct	\$14,597	\$13,657
Indirect & Induced	\$16,230	\$4,960
Total	\$30,827	\$18,617
Multiplier	1.24	0.75
Gross Output		
Direct	\$24,823	\$24,823
Indirect & Induced	\$36,326	\$19,858
Total	\$61,149	\$44,681
Multiplier	2.46	1.80
Wages & Salaries		
Direct	\$9,950	\$9,378
Indirect & Induced	\$10,760	\$3,048
Total	\$20,710	\$12,426
Employment		
Direct	120	113
Indirect & Induced	165	72
Total	285	185
Multiplier	2.38	1.64
Taxes		
Federal	\$4,647	\$2,127
Provincial	\$3,680	\$1,683
Local	\$1,224	\$560
Total	\$9,551	\$4,370
Imports		
From Other Provinces	\$4,335	\$1,948
From Other Countries	\$2,377	\$1,080
Total	\$6,712	\$3,028

Source: Econometric Research Limited and VTPI (2007)



Environmental Impact Results

The CO₂ emission savings sustained by this CAP are substantial. The CO₂ generated by spending the avoided costs add up to 23,024 tonnes. The direct savings on driving less kms per person per day add up to 44,284 tonnes CO₂. The total emission savings are much larger as fewer cars will be produced as less depreciation and wear and tear are sustained. The total emissions saved on these operational and capital costs add up to 231,736 tonnes CO₂ for a net savings of 208,714 tonnes annually.

Expanding Green Spaces - CAP #9

City planners around the world have developed parks, planted trees and set aside open space in urban environments. The terms “green space” and “open space” all refer to urban design elements meant for recreation or improving a neighborhood’s aesthetic appeal — trees and other plants in parks, sidewalks or elsewhere; public plazas, schoolyards and playgrounds; and public lands covered with trees, shrubs and grass. Such projects can also function as “green infrastructure,” helping mitigate the urban heat island effect, filtering air, reducing runoff and

absorbing carbon. In recent years, researchers have been looking into another potential benefit of green space and vegetation — improvements to public health. A brief summary of many different benefits of green space is given below:

- Green space and parks improve property value. There is a significant link between the value of a property and its proximity to parks, greenbelts and other green spaces. Studies of three neighborhoods in Boulder, Colorado, USA, indicated that property values decreased by \$4.20 for each foot away from a greenbelt.³
- Green space helps in decreasing cooling or air conditioning costs. According to the California Energy Commission: “Planting the correct trees, shrubs, vines and groundcover can make a home both warmer in the winter and cooler in the summer. In fact, the right type of tree can reduce summer cooling costs by 20 to 40 percent!”⁴ Computer models devised by the U.S. Department of Energy predict that the proper placement of only three trees will save an average household between \$100 and \$250 in energy costs annually.⁵ The cooling effect of an average size lawn is equal to about 9 tons of air conditioning.⁶
- Views of plants at work places increase job satisfaction. Employees with an outside view of plants experience less job pressure and greater job satisfaction than workers viewing man-made objects or having no outside view. They also report fewer headaches and other ailments than workers without the view.⁷
- Nature increases worker productivity. Psychologists have found that access to plants and green spaces provides a sense of rest and allows workers to be more productive.⁸
- Landscaping renews business districts. Greening of business districts increases community pride and positive perception of an area, drawing customers to the businesses.⁹
- Quality landscaping means quality goods. A recent study found that consumers would be willing to pay, on average, a 12% premium for goods purchased in retail establishments that are accompanied by quality landscaping.¹⁰

³ University of Washington, College of Forest Resources. 2000. The Freeway Roadside Environment: Testing Visual Quality at the Road Edge.

⁴ <http://www.cfr.washington.edu/research.envmind/Roadside/Rsd-Prefs-FS9.pdf>

⁵ The Urban Institute: The Public Value of Urban Parks;

http://www.projectevergreen.com/resources/311011_urban_parks-2.pdf

⁶ California Energy Commission; <http://www.consumerenergycenter.org/home/outside>

⁷ Pioneer Thinking; <http://www.pioneerthinking.com/landscape.html>

⁸ Virginia Cooperative Extension: Nutrient Management; <http://www.ext.vt.edu/pubs/turf/430-400/430-400.html>

⁹ Virginia Cooperative Extension: The Value of Landscaping; <http://www.ext.vt.edu/pubs/envirohort/426-721/426-721.html#TOC>

¹⁰ Virginia Cooperative Extension; op. cit.

- Employment and tourism boost. Employment opportunities are associated with the creation and long term maintenance of urban open space, as well as tourism dollars of visitors from parks, gardens and civic areas (Woolley 2003).¹¹
- Increases retail activity. Studies have proven that greenery and flowers attract shoppers and residents to urban areas...spurring economic growth.¹²
- Business growth. Small businesses choosing a new business location rank the amount of open space and proximity to parks and recreation as the number-one priority in site selection.¹³
- Protects drainage systems. Trees intercept rainfall, reduce runoff rates and increase infiltration. Reduced urban canopy means more storm water for city to manage. It specially affects older cities with aging drainage systems.¹⁴

It would be useful and quite relevant to estimate many economic impacts of green spaces. This is, however, difficult as many of these benefits are not precisely quantifiable. This does not mean in any sense that these benefits are not real or substantive. In our analysis, we concentrate on a small subset of these benefits where we attempt to quantify the required inputs and their economic impacts, in much the same way, as we have estimated the economic benefits of other climate action priorities.

Assumptions

As of 2009, Hamilton had a total of 64,200 trees in parks. In the same year, the stock of trees in front of houses in Hamilton exceeded 181,900. A total of 6,000 trees were planted in 2013. Between 2005 and 2011 an average of 3,750 trees were planted annually. In 2014 and 2015 almost 12,000 trees were planted. We will assume that a similar number of trees will be planted on an annual basis in order to meet the target of raising the urban forest cover from 18.76% in 2009 to 35% in 2030.

The following assumptions are made about the cost of planting trees:

- Cost / tree:
 - \$1.00 to grow
 - \$2.50 to plant
 - \$1.50 to care
 - \$5.00 total

¹¹ Virginia Cooperative Extension; op. cit.

¹² Wolf, Kathleen. University of Washington: _Economic and Public Value of Urban Forests; <http://www.cfr.washington.edu/research.envmind/urban.html>

¹³ University of Southern California: Teen and Adult Perceptions of Urban Green Space Los Angeles; <http://www.colorado.edu/journals/cye/>

¹⁴ Hauer, Jeanne: 'WOW! in the Warehouse District' Green-Space Project to Accelerate Downtown Development; <http://www.wowinwarehouse.com/>

Further, we shall use the U.S. Department of Energy estimates that every three trees reduce household energy costs by \$250 annually. There is also considerable recent evidence that every 1% increase in green spaces reduces total system health costs by an equivalent 1%.

Table 20
Green Spaces Related Savings and Costs

Number of Trees	12,000
Labour per tree	\$3.50
Materials per tree	\$1.50
Total Labour	\$42,000
Total Materials	\$18,000
Household Energy Savings per Tree	\$83
Total Energy Savings	\$1,000,000

Source: Econometric Research Limited and
U.S. Department of Energy

The Economic Impact Results

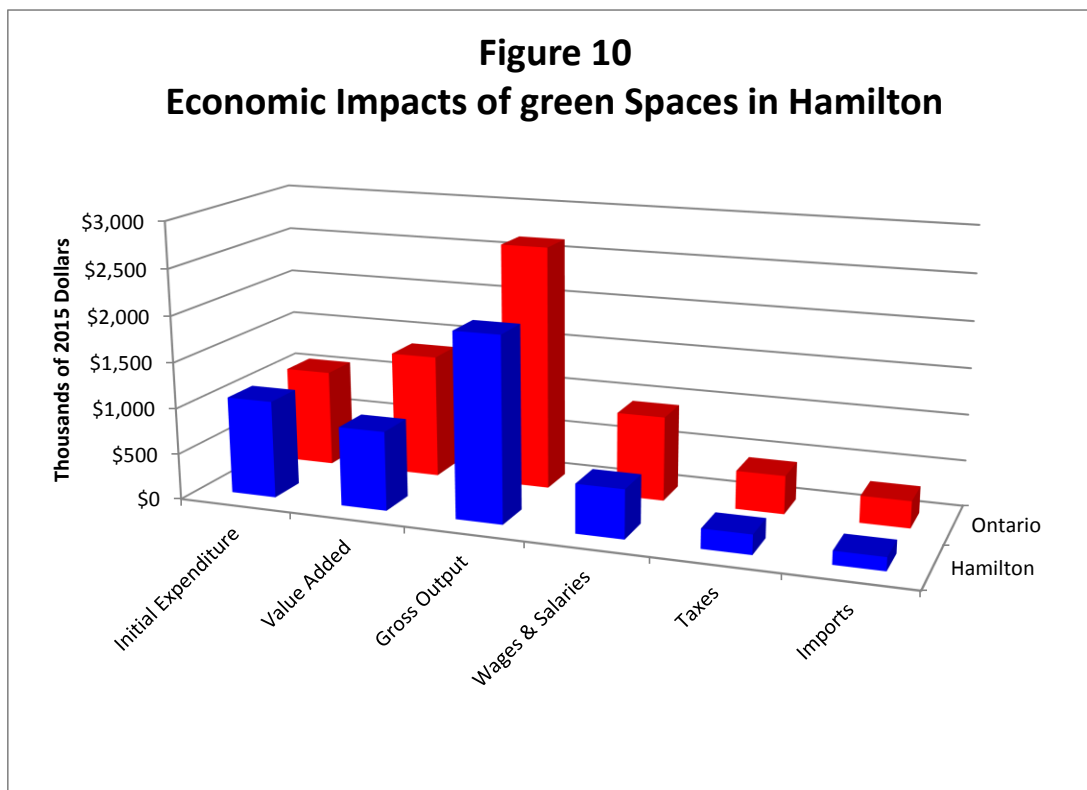
The Economic impact results are displayed in Table 21 and Figure 10.

- Total income of Ontario is increased by about \$1.3 million, of which \$860 thousand is the share of Hamilton.
- Wages and salaries are augmented by about \$920 thousand sustaining net direct effective wages of \$72,478 and a total wage of \$68,699. Hamilton's share is about \$529 thousand.
- Over 13.4 FTEs of employment are generated by this action plan in Ontario, of which 7.3 FTEs will be in Hamilton.
- A total of about \$417 thousand are collected by the three levels of government on these impacts with the City of Hamilton collecting about \$27 thousand.

Table 21
Economic Impacts of Green Spaces in Hamilton
(2015 Dollars)

	Ontario			Hamilton		
	Planting Trees	Energy Savings	Total	Planting Trees	Energy Savings	Total
Initial Expenditure	\$60,000	\$1,000,000	\$1,060,000	\$60,000	\$1,000,000	\$1,060,000
Value Added						
Direct	\$48,913	\$590,241	\$639,154	\$46,437	\$552,380	\$598,817
Indirect & Induced	\$51,105	\$658,780	\$709,885	\$33,343	\$227,620	\$260,963
Total	\$100,018	\$1,249,021	\$1,349,039	\$79,780	\$780,000	\$859,780
Multiplier	1.67	1.25	1.27	1.33	0.78	0.81
Gross Output						
Direct	\$60,000	\$1,000,000	\$1,060,000	\$60,000	\$1,000,000	\$1,060,000
Indirect & Induced	\$106,570	\$1,485,428	\$1,591,998	\$59,539	\$880,000	\$939,539
Total	\$166,570	\$2,485,428	\$2,651,998	\$119,539	\$1,880,000	\$1,999,539
Multiplier	2.78	2.49	2.50	1.99	1.88	1.89
Wages & Salaries						
Direct	\$46,961	\$402,402	\$449,363	\$45,185	\$379,391	\$424,576
Indirect & Induced	\$34,141	\$437,057	\$471,198	\$22,507	\$82,311	\$104,818
Total	\$81,102	\$839,459	\$920,561	\$67,692	\$461,702	\$529,394
Employment						
Direct	1.3	4.9	6.2	1.3	4.6	5.9
Indirect & Induced	0.5	6.7	7.2	0.3	1.1	1.4
Total	1.8	11.6	13.4	1.6	5.7	7.3
Multiplier	1.38	2.37	2.16	1.23	1.24	1.24
Taxes						
Federal	\$15,215	\$188,117	\$203,332	\$12,257	\$91,643	\$103,900
Provincial	\$11,739	\$148,771	\$160,510	\$9,461	\$72,345	\$81,806
Local	\$3,906	\$49,505	\$53,411	\$3,148	\$24,073	\$27,221
Total	\$30,860	\$386,393	\$417,253	\$24,866	\$188,061	\$212,927
Imports						
From Other Provinces	\$12,232	\$176,256	\$188,488	\$8,643	\$84,017	\$92,660
From Other Countries	\$6,873	\$96,938	\$103,811	\$4,830	\$46,889	\$51,719
Total	\$19,105	\$273,194	\$292,299	\$13,473	\$130,906	\$144,379

Source: Econometric Research Limited



Environmental Impact Results

Planting trees and re-spending energy savings sustain the generation of 972 tonnes of CO₂. The reduction of energy use saves a total of 529 tonnes of CO₂ for a net addition of 443 tonnes of CO₂ annually.

Establish an Ongoing Oversight and Coordination Body to Guide Implementation of the Hamilton Climate Change Action Plan and Report Back on Community Progress and Success - CAP #10

The actions and opportunities described within the Climate Action Priorities will require the efforts of many members of the community to move it from a plan to reality. Both the City of Hamilton and community partners have a large role in implementing these components of the Plan. The City and community committee will work together in a shared partnership to act as a facilitator and process stewards. A new Hamilton Climate Action Coordinating Committee will be needed to monitor operations and activities and to provide strategic direction, input, and expert knowledge to the Climate Action Coordinator and partnership.

Assumptions

- Program goal - streamline policies and regulations, and monitor the implementation of CAP.

The Economic Impact Results

The economic impact results are presented in Table 22 and Figure 11. These are relatively modest and include the following.

- Total income of Ontario is increased by about \$207 thousand, of which \$129 thousand will be in Hamilton.
- Wages and salaries are augmented by about \$149 thousand sustaining net direct effective wages of \$114,286 and a total wage of \$82,778. Hamilton's share is about \$100 thousand.
- Over 1.8 FTEs of employment are generated by this action plan in Hamilton and Ontario.
- A total of about \$65 thousand will be collected by the three levels of government on these impacts, with the City of Hamilton collecting about \$4 thousand.

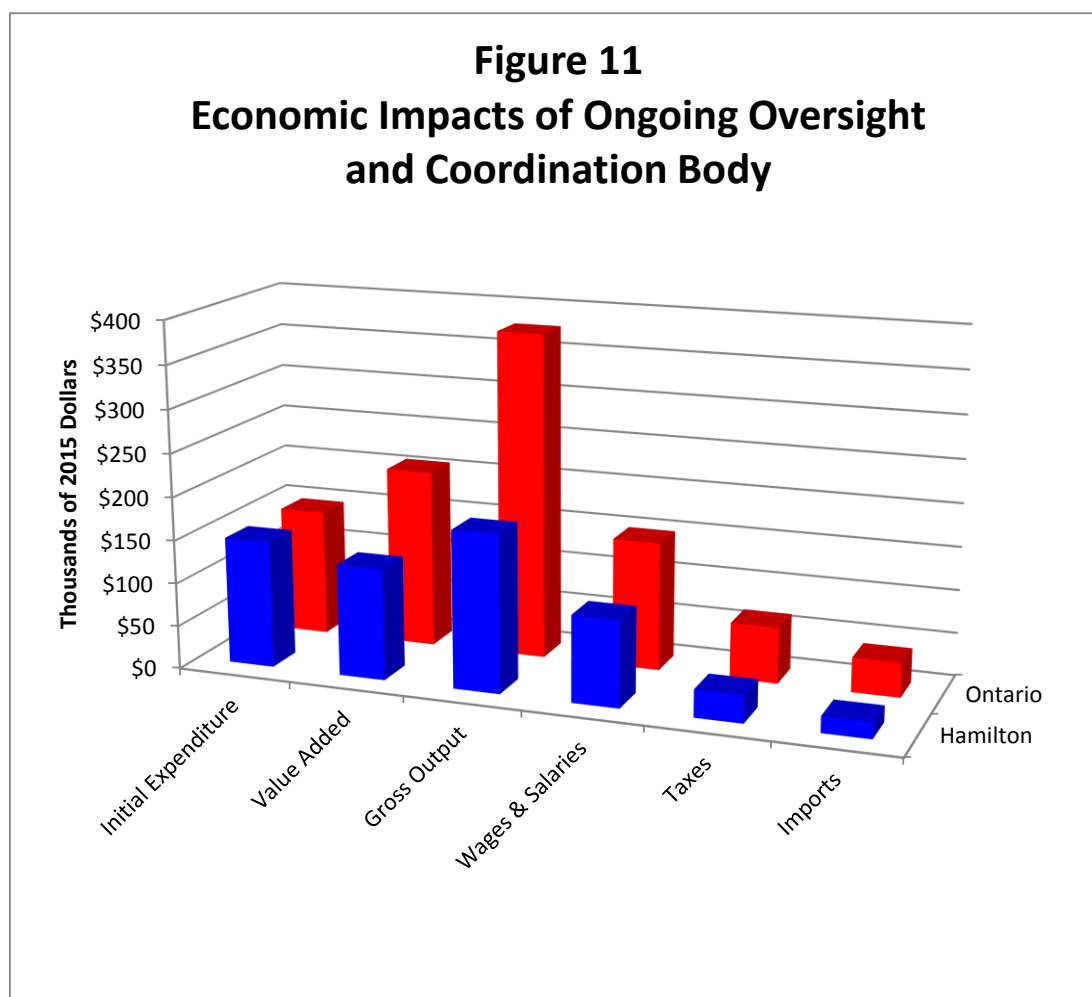


Table 22
Economic Impacts of Ongoing Oversight and
Coordination Body
(Thousands of 2015 Dollars)

	Ontario	Hamilton
Initial Expenditure	\$147	\$147
Value Added		
Direct	\$104	\$104
Indirect & Induced	\$103	\$25
Total	\$207	\$129
Multiplier	1.42	0.69
Gross Output		
Direct	\$147	\$147
Indirect & Induced	\$230	\$35
Total	\$377	\$182
Multiplier	2.57	1.24
Wages & Salaries		
Direct	\$80	\$80
Indirect & Induced	\$69	\$20
Total	\$149	\$100
Employment		
Direct	0.7	0.7
Indirect & Induced	1.1	0.2
Total	1.8	0.9
Multiplier	2.57	1.29
Taxes		
Federal	\$32	\$16
Provincial	\$25	\$12
Local	\$8	\$4
Total	\$65	\$32
Imports		
From Other Provinces	\$26	\$12
From Other Countries	\$14	\$7
Total	\$40	\$19

Source: Econometric Research Limited

Environmental Impact Results

The monitoring, oversight and coordination activities will generate 115 tonnes of CO₂. This is the level that should be aimed at saving by the proper exercise of the oversight program that targets the effective and efficient implementation of the 10 CAPs.

Conclusions

The City of Hamilton has joined the small group of communities in Canada that have taken seriously the likely impacts of climate change and have moved proactively to reduce their ecological footprint and decrease their green gas emissions responsible for global warming.

The City conceived a number of priority actions under its community Climate Action Plan to reduce CO₂ emissions in order to improve the local air quality and increase the adaptive capacity and resiliency of the City to deal and reduce the likely impacts of climate change.

There is a general misconception that environmental initiatives are costly and constrain the economy. The economic impact results that will be generated by the proposed priority actions of Hamilton's Climate Action Plan discussed in this study show clearly that environmental initiatives can also boost the local economy by creating meaningful and high-paying jobs, increase household incomes and augment the local fiscal base of the community. They do so through three channels. First, there are expenditures on materials and labour to establish the projects and programs. Second, there are also expenditures on labour, materials, insurance, utilities, etc. to operate the projects and programs. These are referred to as the operational and maintenance expenditures. Third, the initiatives result in energy and water savings. The avoided costs (savings) are realized by households, businesses and institutions. Once these savings are re-spent on the typical bundles that households (consume) and businesses (invest in) purchase they generate additional economic benefits.

The sum of these three streams of expenditures generates and sustains significant economic impacts both at the local level (City of Hamilton) and the province (Ontario) level. A summary of both the economic and environmental impacts by the various initiatives are presented in Table 23 below.

While the total economic impact of the disparate programs may not be representative or comprehensive as some of the initiatives may not be incremental and additive and a few representative projects do not cover the entire suite of activities and benefits that could be derived from the action plans, still the programs represent a major economic nexus of green activities with substantial economic and environmental impacts.

A total annual gross reduction of about 283,467 tonnes of CO₂ can be expected from the implementation of the CAPs. The net reduction is about 202,920 tonnes of CO₂. The divergence between the gross and net reductions arises on account of added emissions by the new economic expansions generated by the expenditures on the actions and/or their savings of energy and water that are re-spent.

The reduction in CO₂ gas emissions is not the only environmental positive impact. The increased vegetation and improvement in air quality are also predictable outcomes of these CAPs although they are not all quantifiable.

Equally significant is the total number of full-time equivalent jobs that are expected from the impacts of the programs estimated at 1,643.6 FTEs in Ontario, of which 1,123.5 FTEs will be in Hamilton. The local tax base is expected to increase by \$40.9 million as all levels of government will reap tax revenues on the positive impacts. The local government is expected to increase its revenues by \$3.3 million annually. Local incomes (City of Hamilton) will increase by \$97.2 million while Ontario's income would rise by \$133.5 million.

A major indicator to note is the total estimate of avoided costs. These will exceed \$69.1 million and will represent savings to households, businesses and governments.

The priority list of initiatives and actions is based on realized savings that are cost effective in the sense that there will be no out of pocket expenses by households above the realized savings. If anything the re-spent portion arises because the out of pocket expenses will fall short of the realized savings either because of efficiencies and/or public support programs.

Table 23
Estimated Annual Impacts of the Climate Action Plan Priorities in Hamilton

Climate Action Plan		A. Environmental Impacts			B. Province Wide Economic Impacts					C. Regional Economic Impacts in Hamilton				
		GHG Emissions (tonnes CO2/year)			\$000's	\$000's	\$000's	\$000's		\$000's	\$000's	\$000's	\$000's	
		Gross	Reduction	Net	Total Investment and Incremental Expenditures	Gross Economic Activity	Value Added to Provincial Economy	Tax Revenue to all Levels of Government	Provincial Employment (FTEs)	Avoided Cost	Gross Local Economic Activity	Value Added to Local Economy	Tax Revenue to Local Government	Local Employment (FTEs)
1	Support Local Food Production and Consumption	16,072	3,541	12,531	\$36,638	\$86,268	\$46,925	\$14,052	842.0		\$76,489	\$44,572	\$1,737	604.0
2	Establish On-Going Education and Awareness Program Campaign	34		34	\$40	\$116	\$42	\$13	0.5		\$61	\$22	\$1	0.3
3	Develop a Community Energy Plan to Guide Hamilton's Energy Future	5,467	8,585	-3,118	\$5,892	\$14,644	\$7,359	\$2,275	68.4	\$5,892	\$10,429	\$4,478	\$142	44.5
4	Revise/Update Infrastructure Guidelines (annualized)	11,412	23,692	-12,280	\$12,304	\$30,310	\$15,280	\$4,734	141.1	\$12,304	\$22,394	\$9,351	\$278	91.7
5	Establish Variable Development Charges and Water Rates set to reflect real cost (10%).	14,606	8,336	6,270	\$15,747	\$38,791	\$19,555	\$6,059	181.0	\$15,747	\$28,345	\$11,810	\$355	118.0
6	Create an Accessible Tool Kit for SMEs to assist with impact analysis and Business Community Planning (one-time cost)	209		209	\$250	\$639	\$334	\$106	3.2		\$488	\$251	\$7	2.1
7	Conduct a Local Community Vulnerability assessment of Public Health Impacts from Climate Change	8,634	7,045	1,589	\$9,343	\$23,015	\$11,602	\$3,595	107.2	\$9,343	\$16,537	\$7,101	\$211	69.7
8	Expand Local Transit Services to include a dedicated Rapid transit Lanes	23,024	231,738	-208,714	\$24,823	\$61,149	\$30,827	\$9,551	285.0	\$24,823	\$44,681	\$18,617	\$560	185.0
9	Protect and preserve green spaces	972	529	443	\$1,060	\$2,652	\$1,349	\$417	13.4	\$1,000	\$2,000	\$860	\$27	7.3
10	Establish an Ongoing Oversight and Coordination body to Guide and report on Hamilton's Climate Change Action Plan.	115		115	\$147	\$377	\$208	\$66	1.8		\$182	\$129	\$4	0.9
TOTAL		80,546	283,467	-202,920	\$106,244	\$257,961	\$133,481	\$40,868	1,643.6	\$69,109	\$201,606	\$97,191	\$3,321	1,123.5

Source: Econometric Research Limited

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