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Specification and Evaluation of Alternate Projections of the Magnitude and Structure of the Ontario Economy to 2020

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Prepared by:

Richard DiFrancesco

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By

Richard DiFrancesco

Contact: rick@regionalanalytics.net

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Executive Summary

The Province of Ontario is entering a period of heightened uncertainty with respect to its economic fortunes – a degree of uncertainly which underscores the caveats which usually accompany any long-term economic forecasting exercise. With this in mind, the analysis reported herein is motivated by a desire to produce plausible pictures of a future Ontario, in 2020. No one picture is more plausible than any other, and there is no guarantee that any of these scenarios will actually materialize. That said, the future will likely include portions of these scenarios and, in that way, these scenarios will provide some idea as to where vulnerabilities and potentialities lie.

Much has been written and/or discussed relating to the fact that Ontario's population, and hence its labour force, is getting older with time and the fact that, as a result, certain types of labour are likely to be in short supply in the near future. Indeed, governments ranging in size from municipal councils to the Government of Canada have studied the so-called aging population issue and its likely implications for their respective jurisdictions. While the estimates of the severity of the problem vary, all agree that the demographic structures of our towns, cities, provinces and ultimately of Canada as a whole, are becoming progressively "top-heavy". As a result of this aging demographic structure, dependency ratios at all scales are increasing as the employed labour force

becomes progressively smaller relative to the "dependent population" (i.e., those under 15 years of age, and those over 65)). Perhaps most importantly, this aging demographic structure, stands to impact various components of the economy disproportionately. Indeed, considerable evidence exists to suggest that, in the near future, the skilled occupations (due to the confluence of an aging work force and declining apprenticeship rates in many skilled occupations) at multiple spatial scales stand to experience the most significant shortfalls in the numbers of workers available to fill essential positions (Ontario Chamber of Commerce, 2006; Conference Board of Canada, 2007). As a result, given the potential of this aging population/workforce issue to overshadow and bleed into all other growth/change scenarios, all scenarios considered herein are analyzed not only in terms of their industrial implications, but also in terms of their labour demand (i.e., employment) implications on an occupation-specific basis. By including this focus on the occupational structure of projected employment in Ontario out to 2020, it is our hope that this report will inform discussions relating to occupation- or skill-specific planning and policy issues.

The analysis focuses on five scenarios of possible growth/decline and change in the Province of Ontario out to 2020 including a baseline scenario, two expansionary scenarios and two contractionary scenarios. The expansionary scenarios focus on large infrastructure projects in Ontario, while the contractionary scenarios focus on fundamental issues facing Ontario's manufacturing core (e.g., a skills gap and declining demand for motor vehicles manufactured in Ontario). Scenario 1 (SC1) posits a situation where manufacturers in Ontario are unable to secure sufficient supplies of skilled labour to meet their needs. SC1 is based on an analysis completed by the Conference Board of Canada (2007) which estimates that Ontario could experience a shortfall of 190,000 workers by 2020, and by work done by the Ontario Chamber of Commerce (2005) which suggests that such a deficit would be concentrated in the skilled occupations and have a disproportionate impact on the manufacturing sector of the provincial economy. SC1, which posits a $40 billion decline in manufacturing output of Ontario from 2004 to 2020, is projected to have a total

(negative) provincial impact of nearly $115 billion (including nearly $22 billion in lost labour income) over the period from 2004 to 2020. While this shock is not sufficient to pull the province into a period of declining output, its growth relative to the baseline over the period from 2004 to 2020 is significantly retarded.[1] Scenario 1 (SC1) shows that all industries in Ontario, and thereby workers in all industries from high-level professionals to lower-skill occupations stand to be affected by the aging workforce problem in Ontario. For example, Table A1 shows that under SC1, two occupational groups, "Processing, Manufacturing and Utilities Supervisors and Skilled Operators" and "Labourers in Processing, Manufacturing and Utilities", two highly skilled trades, account for nearly 40 percent of the total shortfall in jobs created over the period, relative to the baseline scenario. In absolute terms, these two occupations will see their total employment levels decline by more than 129,000 positions (relative to the baseline scenario) over the period. In other words, a shortfall in the supply of skilled workers has the potential to cause a significant decline in manufacturing activity in Ontario over the period which, through direct, indirect and induced impacts, can potentially lead to the loss of an additional 129,000 skilled workers over the period. SC1 provides a glimpse of a self-sustaining, and indeed accelerating, process of skilled worker loss in Ontario and its associated economic implications.

Scenarios 2 and 3 (SC2 and SC3) focus on large infrastructure projects which are likely to be seen in Ontario over the time horizon considered in this analysis. In SC2, water, waste-water and transportation infrastructure projects amount to an estimated $52 billion in expenditures over the period, resulting in a total province-wide impact (across all industries) of nearly $165 billion over the period (this includes labour income earned of $35 billion). In addition, SC2

[1] It is important to note that scenarios SC1 to SC4 are treated as being increments or decrements to the baseline totals. The baseline scenario was crafted on the basis on a fairly optimistic long-term view put forward in the Ministry of Finance's long term outlook (Ministry of Finance, 2005). As such, none of the 4 scenarios are conceived as taking place against this backdrop, acting to mute or enhance expected growth in Ontario.

generates demand for more than 796,000 additional workers in Ontario over the period, with nearly one in three required in the "Trades and Skilled Transport and Equipment Operators" occupational group. Scenario 3 (SC3), another large infrastructure scenario, calls for the implementation of the Ontario Power Authority's Integrated Power System Plan (IPSP) over the period. SC3 includes approximately $60 billion in expenditures on refurbishing and expanding Ontario's power generation and distribution systems. The total impact of the scenario over the period is projected to be in excess of $191 billion (including nearly $42 billion in labour income). Like SC2, SC3 will likely generate massive employment impacts across Ontario, in excess of 959,000 positions, with nearly one in three in the "Trades and Skilled Transport and Equipment Operators" occupational group.

While SC1 presents a glimpse of a potentially self-sustaining and perhaps accelerating process of skilled worker loss, SC2 and SC3 present the opposite – scenarios whereby demands are likely to outstrip supply by such an extent that calls for training and in-migration to Ontario could significantly increase the province's supply of skilled workers over the period (of course the amelioration of supply and demand would undoubtedly require focused apprenticeship programs, in combination with other measures including delayed retirements, the more efficient processing of out-of-province (or indeed, out-of-country) credentials, and concerted educational campaigns to make young people aware of the potential offered by the skilled trades). In each of SC2 and SC3, nearly one in five positions to be created over the period would fall into a loosely defined "creative class" – those occupations involving some combination of creativity, higher education and professional status/certification. This is not surprising given that SC2 and SC3 would place heavy demands on high-level services such as engineering, finance, law, science, architecture, planning and design, to name a few.

The fourth scenario, SC4, is another contractionary scenario focusing on a substantial decline (50%) in the demand for motor vehicles produced in Ontario. In this scenario, a reduction in motor vehicle production activities over the period

of approximately $23 billion has a total impact on provincial gross output over the period of nearly $55 billion. As well, this decline in motor vehicle manufacturing activity in Ontario in SC4 translates into the loss of 200,000 positions over the period, with nearly one in five falling into the "Processing and Manufacturing Machine Operators and Assemblers" and the "Processing, Manufacturing and Utilities Supervisors and Skilled Operators" occupational groups. Like SC1, SC4 provides a glimpse of a self-reinforcing and perhaps accelerating process of skilled worker and knowledge worker loss in Ontario.

The five scenarios considered below provide at least three different very different views of the possible growth trajectory of the provincial economy. Which, if any, of these trajectories will be realized remains an open question. What is clear however, is that the overall size and structure of Ontario's economy and its labour force is something which stands to be greatly affected over the time frame of this analysis.

Table A1: High-level Summary of the Analysis

Scenario	Output Impact over the Period	% Change in Output Relative to 2004	Per Capita GDP Impact over the Period	Employment Impact over the Period[2]	Most Impacted Occupation over the Period[3]
Base-line	+$853 billion[4]	+56%	$19,187[5]	+3.7 million	Skilled Occupations in Primary Industries (+178%)
SC1	-$115 billion[6]	+46%[7]	$16,436	-492,000	Processing and Manufacturing Machine Operators and Assemblers (-19%)
SC2	+$165 billion	+69%	$23,324	+796,000	Trades Helpers, Construction Labourers and Related Occupations(+43%)
SC3	+$191 billion	+71%	$24,078	+959,000	Trades Helpers, Construction Labourers and Related Occupations (+37%)
SC4	-$55 billion	+51%	$18,139	-200,000	Processing and Manufacturing Machine Operators and Assemblers (-8%)

[2] The percentage for the baseline scenario shown in this column is relative to the 2001 total. Under the baseline scenario, for example, by 2020 we project an additional 3.7 million employees over and above 2001 levels. Values shown in the bottom four rows of this column are relative to the total projected in the baseline scenario. For example, under SC1, the loss of $40 billion in manufacturing output over the period translates into 492,000 fewer jobs created relative to the baseline value of 3.7 million.

[3] The percentage change values shown in this final column of the table are computed relative to the number of people in the employed labour force in 2001 included in each of the occupational major groups. For example, under the baseline scenario, "Skilled Occupations in Primary Industries" are projected to increase by 178% over 2001 levels.

[4] Gross industry output, over all industries in 2020, exceeds the observed 2004 total by approximately $853 billion.

[5] Based on a GDP (basic price) impact of nearly $284 billion over the period (i.e., the difference between projected 2020 GDP and observed GDP in 2004) and an estimated total population in Ontario of 14.8 million people by 2020 (an additional 2.4 million people relative to 2004). (Ministry of Finance, 2008).

[6] Gross industry output, over all industries in 2020 under SC1, is projected to be approximately $115 billion less than that projected under the baseline scenario. In other words, the loss of $40 billion in manufacturing activity over the period, through direct, indirect and induced effects, has a total impact over the period of approximately -$115 billion (where the "impact" is defined as the difference between what the status quo could potentially generate over the period, and what is projected under the specific scenario).

[7] The total output of all industries in 2020 is computed as the sum of the baseline and SC1. In this case, SC1 reduces the magnitudes in the baseline scenario, but by 2020, the total output from all industries in the province is still projected to be larger than it was in 2004 – hence the positive percentage value. Each scenario is seen to be either a decrement or an increment to the baseline scenario. SC2 results in the augmentation of the baseline values, as does SC3. SC4 however also results in the reduction of the baseline scenario values. In all cases, the percentage changes are positive reflecting the fact that all scenarios include growth beyond 2004 values by 2020. The two contractionary scenarios simply refer to cases whereby the growth posited under the baseline scenario is reduced to some extent.

1.0 Introduction

The Province of Ontario, with a population of more than 12 million people and a labour force of more than 7 million, accounts for approximately 40 percent of all employment in Canada. Ontario is unquestionably the economic engine that drives Canada, and which accounts for the majority of its value-added production. While Ontario has enjoyed a period of sustained growth over the past 15 years, Ramsay (2008) notes that "…there are clear signs that the resilience of Ontario's economy is being tested."[8] The so-called "Ramsay Report" was written in response to concerns that Ontario's manufacturing sector, in particular, is heading into a period of uncertainty and change as a result of sweeping global macroeconomic forces (among other changes) including fluctuations in the value of the Canadian Dollar, volatility in energy prices (most notably a prolonged surge in the price of crude oil), and an economic recession in the United States of America (US) and Canada which stands to have a disproportionately large impact on Ontario given its position as an exporter of manufactured goods primarily to the US.

While these broad sweeping macroeconomic forces do stand to affect the nature and size of Ontario's economy into the future, there are many other "home-grown" processes and economic realities which stand to drastically affect the future size and structure of the provincial economy. These include (among others):

- Demographic change and its impact on the size and composition of the provincial labour force;
- The spatial distribution of population and employment within the province and specifically its degree of internal and external connectivity vis-à-vis transportation infrastructure; and;

[8] Ramsay, D. (2008). "Manufacturing in Ontario: Innovating for the Future". http://www.ontario-canada.com/ontcan/en/manufacturing_ramsayreport_en.jsp

- The imminent upsurge in megaprojects across Ontario related to the refurbishing and expansion of the province's core power- and water-related infrastructure systems.

The Conference Board of Canada (2007) shows that the demographic complexion of Ontario's labour force is changing as a result of a population that is growing (and will continue to grow) more slowly than in the past, and which is therefore becoming older with time. The Conference Board of Canada (2007) notes that Ontario could face a shortfall of 190,000 workers by 2020 rising to as much as 364,000 workers by 2025. More compelling is their finding that by as early as 2014, the supply of workers in the Province of Ontario could fall below what is demanded by employers (see Figure 1).[9] The Ontario Chamber of Commerce (2006) notes that this labour shortage will be especially acute in terms of skilled workers, and that over the next 15 years, if not corrected, it could cost the Ontario economy $40 Billion in lost manufacturing output.[10]

Central to the health and well-being of the manufacturing megalopolis known as the Greater Golden Horseshoe (GGH) – which is the core of the provincial economy – is the efficient movement of goods and people. Industries require skilled workers and skilled workers demand housing with a specific attribute bundle. The economics of firm and residential location selection processes in the GGH has generated a system whereby workers (on average) are spatially dislocated from employment destinations. This, exacerbated by attendant suburban and exurban retail and commercial development, has given rise to an ever more auto-dependent society in Ontario. As a result, if left unchecked, these locational decision making processes in combination with an expected additional 3.7 Million people in the region, have the potential to increase grid-lock by as much as 45 percent by 2031.[11] Clearly, part of the

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[9] Conference Board of Canada (2007). "Ontario's Looming Labour Shortage Challenges: Projections of Labour Shortages in Ontario, and Possible Strategies to Engage Unused and Underutilized Human Resources." http://www.workforcecoalition.ca/conference_board_report.pdf

[10] Ontario Chamber of Commerce (2006). "Retooling for a Prosperous Ontario: A Global Perspective on Skilled Trades." http://occ.on.ca/Policy/Reports/266

[11] Ontario (2007). "ReNew Ontario: Progress Report 2007 – Building a Better Ontario". http://www.pir.gov.on.ca/english/infrastructure/renew/2007/pdf/RO2007_Final_Eng.pdf

solution will involve maintaining, refurbishing and expanding the capacity of provincial transportation system to move people and goods between points in space efficiently and economically.

While transportation infrastructure is certainly a critical variable in the processes working to determine Ontario's future economic condition, so to is the hard infrastructure system that supplies water and sanitation for Ontario's rapidly urbanizing population. The Water Strategy Expert Panel (WSEB) (2005) notes that in Ontario, "…water-related assets are wearing out, and most communities are not replacing them quickly enough."[12] The WSEP goes on to note that "…unless the rate of capital investment increases sharply from the levels of the recent past, Ontario will face a gap of roughly $18 billion between what systems need and what they receive in funding over the next 15 years."[13]The WSEB estimates that deferred maintenance as well as the demands of anticipated growth will require that $34 billion be invested in the repair and expansion of the water and wastewater systems in Ontario's municipalities over the next 15 years. Without this level of investment, potential losses from catastrophic system failures (e.g., bursting water mains, flooding sewer systems etc.) and from impacts on human health (e.g., Walkerton, ON) will be massive. Given that much of the new knowledge-based economy of Ontario is dependent upon underground systems which pre-date the automobile, much needs to be done to ensure another century of growth and innovation in Ontario. The Government of Ontario, and many local municipalities are already dealing with the problems associated with aging systems, but there is little doubt that the next one to two decades will see substantial levels of activity in these areas.

Another aspect of Ontario's underlying framework that supports all economic activity in the province, and one which is in need of substantial investment, is the power generation and distribution system. The Integrated

[12] Water Strategy Expert Panel (2005). "Watertight: The case for change in Ontario's water and wastewater sector.", Report of the Water Strategy Expert Panel. p.7 http://www.waterpanel.ontario.ca/mbs/pir/Waterpan.nsf/WebContent?ReadForm&PageID=Home1&Lang=EN

[13] ibid., p.7.

Power System Plan (IPSP) put forward by the Ontario Power Authority (OPA) to address issues around the accommodation of future growth in demand for electricity in Ontario, needed generation and transmission system maintenance, and enhanced environmental sustainability via the increased use of renewable energy sources and the phase-out of coal-fired generating plants in Ontario by 2014. Implementing the IPSP in Ontario will require the investment of $60 billion over the next 20 years. The IPSP will not only ensure that Ontario has sufficient capacity to support population and economic growth into the foreseeable future, but it will also go a significant distance toward reducing the ecological footprint of Ontario's power generation activities by removing coal-fired generating plants from the supply-mix, and replacing that capacity with a blend of conservation efforts, nuclear power, natural-gas-fired generating stations, and increased use of renewable sources (e.g., hydroelectric).

Clearly, the next two decades are likely to be turbulent for the Province of Ontario and its economy. Factors and forces are simultaneously pointing toward periods of expansion and contraction (operating at very different time scales). The purpose of this report is to develop a set of plausible pictures of the size and structure of the provincial economy in 2020 within this context. Given that many scholars and practitioners have noted that there is likely to be a shortage of skilled labour in the future, and this author's belief that this issue is likely to overshadow all others in the near future, all scenarios considered will be evaluated in terms of the possible impact on the demand for labour in the province. More specifically, possible employment demand levels for each scenario will be expressed in terms of specific occupational groups (1997 NOCs). In addition, the overall total gross output impact, as well as the industry-specific impacts, will be presented. While nothing herein can be considered to be a forecast, these projections can be used as indicators of possible future states of Ontario's economy.

In what follows, we start with a more detailed examination of some of the forces and issues that speak to the potential for change in the nature and magnitude of Ontario's economy. Following this, a methodology for translating

these scenarios into long-term projections of industrial output and labour force characteristics of Ontario out to 2020 will be described. Once described, the results from the application of the model to each of the scenarios will be presented and discussed. Finally, the paper will close with a summary of findings and discussion of future research directions.

2.0 The Way Ahead for Ontario's Economy

2.1 Ontario's Population and Labour Force

As discussed at the outset, the Province of Ontario faces many challenges, but perhaps the most pervasive are those stemming from the region's demographic structure, and the impact of this structure on the province's future population and labour force. In its 2005 long-term outlook for Ontario's economy, the Ontario Ministry of Finance highlights five key demographic trends that are projected to continue and accelerate through 2025 and thereby have a pervasive impact on the province's long-term economic state. These key trends include:

- Slower but still significant population growth in Ontario;
- Increased reliance on immigration as a source of population growth (as opposed to natural increase);
- Increased urbanization of the population;
- Slower growth of the working-age population; and,
- A shift to an overall older age structure. [14]

In its long-term outlook, The Ministry of Finance (2005) discusses several reasons why these trends are important when considering the province's long-term economic and fiscal outlook. Most important from the perspective of this

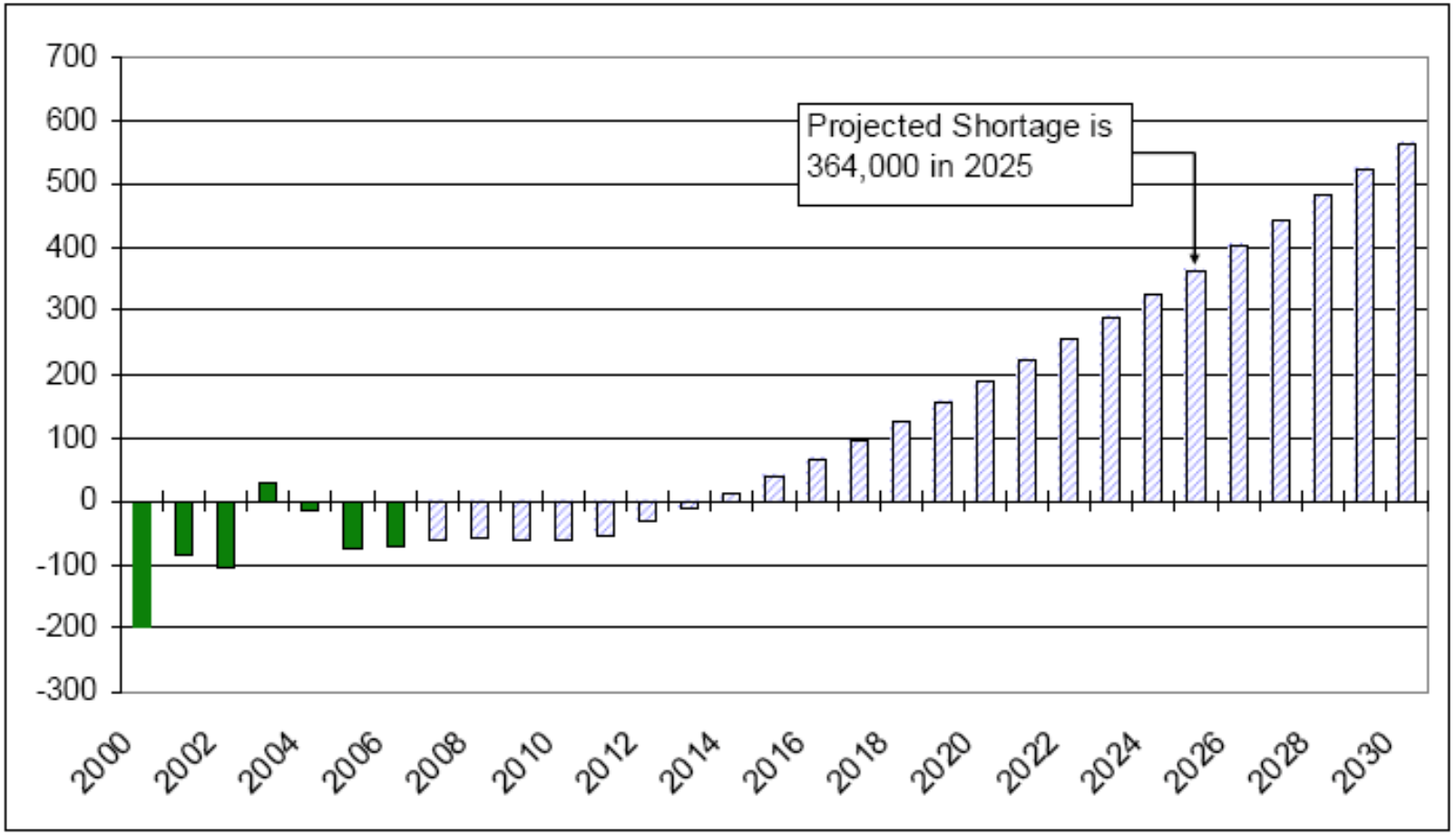
[14] Ontario Ministry of Finance (2005). "Toward 2025: Assessing Ontario's Long-Term Outlook." http://www.fin.gov.on.ca/english/economy/ltr/2005/05_ltr.html

report is the effect of an aging population on the nature of the labour force in Ontario – a primary input to all (present and future) economic activities in the region. The Conference Board of Canada (2007) shows that the demographic complexion of Ontario's labour force is changing as a result of a population that is growing more slowly than in the past, and which is also becoming older. The Conference Board of Canada (2007) notes that Ontario could face a shortfall of 190,000 workers by 2020 rising to as much as 364,000 workers by 2025 as a result of this aging trend (which is a corollary to declining fertility rates). Even more compelling is their finding that by as early as 2014, the supply of workers in the Province of Ontario will fall below what is demanded by employers (see Figure 1).[15] The Ontario Chamber of Commerce (2006)[16] notes that this labour shortage will be especially acute in terms of skilled workers, since skilled occupations are actually aging more quickly than is the general labour force. Specifically, the Chamber notes that Ontario could face a shortage of approximately 100,000 skilled workers in the manufacturing sector alone over the next 15 years, and that Canada as a whole could face a shortage of one million skilled workers as a result of the combined effect of aging and declining birth rates. Failure to address the shortfall in the Province of Ontario could, according to the Ontario Chamber of Commerce (2006), cost the provincial economy $40 billion in lost manufacturing output over the next 15 years. The first scenario to be addressed below will focus on the impacts associated with the loss of 100,000 skilled workers in Ontario over the period from 2008 to 2020.

Scenario #1: Loss of 100,000 skilled workers in the manufacturing sector and a consequent loss of $40 billion in manufacturing output over the period from 2008 to 2020.

[15] Conference Board of Canada (2007). "Ontario's Looming Labour Shortage Challenges: Projections of Labour Shortages in Ontario, and Possible Strategies to Engage Unused and Underutilized Human Resources."
http://www.workforcecoalition.ca/conference_board_report.pdf
[16] Ontario Chamber of Commerce (2006). "Retooling for a Prosperous Ontario: A Global Perspective on Skilled Trades." http://occ.on.ca/Policy/Reports/266

Figure 1: Labour Demand and Supply in Ontario, 2000-2030[17]



[17] Taken from The Conference Board of Canada (2007), pp. 5.

2.2 A Transportation, Water and Wastewater Infrastructure Boom

The production of any good or service requires the use of primary factors of production (e.g., capital, labour etc.). In the study of Urban Economics, the notion of capital is expanded to consider all of the publicly provided hard and soft items which yield on-going services/benefits to urban residents, be they workers or employers (e.g., publicly funded roads, transit, policing etc.). These "urbanization economies" represent strong attractive forces that partially explain the emergence and continued expansion of urban areas. Much has been written about the fact that our current pattern of residential location vis-à-vis employment locations is one which is subsidized by the massive public investments in transportation infrastructure made by governments in Canada, the US and indeed in many nations. It would seem though that the private social benefits of our long-established penchant for suburban development have been eroded to the point where many are now questioning the utility of living so far from where one works or plays or shops. Indeed, the recent surge in fuel prices the world-over has lead people to contemplate a return to a past state where regional comparative advantage was unable to overpower distance decay in the determination of optimal (firm and residential) locations.

While it is true that the users of our transportation infrastructure typically do not pay the full (social) cost associated with the use of that infrastructure, this is beside the point for the current analysis. The time horizon for this report is from the present out to the year 2020. As such, the current pattern of residential location and journey to work trips etc., is unlikely to change substantially in this time frame. What this means is that in order to ensure continued economic growth and prosperity, governments must maintain and enhance the transportation system even if its configuration is largely counter to the notions of sustainability (though, this does not preclude governments from implementing more sustainable transportation options relative to the status quo, as is evidenced by the current Growth Plan for the Greater Golden Horseshoe). The Province of Ontario generally, and the Greater Golden Horseshoe (GGH) specifically is a case in point. The GGH, which represents the core of the provincial economy is

showing palpable signs of having outgrown its transportation system. The Government of Ontario, Office of the Premier notes that the "…GTA is one of the fastest growing regions in North America, increasing its population by approximately 100,000 people – and 50,000 cars – every year."[18] This incredible growth in the GTA has brought with it significant costs including congestion of the region's surface transportation system. In June of 2007, the Office of the Premier noted that the GTA is the fourth-most congested region in North America trailing behind notable urban centres like Los Angeles, the San Francisco Bay area, and Greater Chicago.[19] In the same communiqué, the Premier's Office notes that "…[a]s businesses increase their speed and efficiency and develop faster production cycles, delivering goods 'just in time' has become more critical than ever….battling congestion costs the GTA $2.2 billion each year."[20] Public transit is also feeling the pressure in the region. Commuting in the GTA now takes 32 percent longer relative to free-flowing conditions, and this is expected to rise to 40 percent by 2031. The environmental cost of this modality of growth is also becoming increasingly evident. Scientists the world-over are now agreed that human actions are influencing the global climate, and that CO_2 and other Greenhouse Gases (GHGs) resulting from these activities are a central cause of global warming.

The Province of Ontario's MoveOntario 2020 plan (The Plan) was announced in June 2007 and it includes a commitment to provide $17.5 billion over 12 years to fund some 52 transportation projects in the Province. Projects will include subway extensions, highway extensions, the electrification of the GO Transit Lakeshore line (to reduce travel time from Hamilton to Union Station by nearly 40 percent), the expansion of capacity on existing GO Transit lines, 902 kilometers of improved rapid transit including two rapid transit lines across the City of Hamilton, and one light rail line across the City of Toronto.[21] The Plan calls for 66 percent of these projects to be completed by 2015, and 95 percent to

[18] See http://www.premier.gov.on.ca/news/Product.asp?ProductID=1384.
[19] Ibid.
[20] Ibid.
[21] See http://www.premier.gov.on.ca/news/Product.asp?ProductID=1384.

be complete by 2020. By 2020, the Province of Ontario generally, and the GGH specifically, could be a very different place than it is today in terms of the cost (social, economic and environmental) of transportation, ease of movement, and overall attractiveness and competitiveness. Not insignificantly, The Plan is designed to generate 800 million new transit trips annually, thereby eliminating some 300 million car-trips from GTA roads. In terms of the province's overall ecological footprint, even with the anticipated population and economic growth to 2020, The Plan is expected to reduce provincial CO_2 emissions by 10 megatonnes.[22]

Water and sewer systems are, for most North Americans, something to be taken for granted. Indeed, the costs associated with building these systems were incurred many decades ago, and maintenance activities are rarely noticed save for the inconvenience of traffic detours around underground repair works. The Water Strategy Expert Panel (WSEP) in 2005 released a report entitled "Watertight: The case for change in Ontario's water and wastewater sector". In terms of its mandate, the WSEP notes that in some respects, the Panel may be seen as being the province's long-term response to the tragedy at Walkerton in May of 2000. As many will recall, in May of 2000, the drinking water system in the Town of Walkerton Ontario, home to 4,800 people, became contaminated with a virulent strain of E.coli, and some 2,300 people became ill, and seven died as a result. Of those who survived, many have suffered permanent damage to their health.[23] For many, the Walkerton tragedy was a wake-up call vis-à-vis the importance of our water and wastewater systems, and the degree to which they have been neglected. Indeed, the WSEP (2005) notes that in Ontario there is currently an "…unpaid bill of $11 billion…." for the maintenance and repair of the existing water and wastewater systems. Given the very high cost associated with the repair and maintenance of these systems, and the political risk associated

[22] Ibid.

[23] Water Strategy Expert Panel (2005). "Watertight: The case for change in Ontario's water and wastewater sector.", Report of the Water Strategy Expert Panel. p.3 http://www.waterpanel.ontario.ca/mbs/pir/Waterpan.nsf/WebContent?ReadForm&PageID=Home1&Lang=EN

with adding these costs to ratepayer's annual tax bills, many necessary, indeed critical, projects have been neglected. Simply put, the water-related assets in many communities in Ontario are "wearing out" and they are not being replaced quickly enough.

The current stock of water and wastewater assets in the province is estimated to be in the range of $72 billion with $20 billion of this in the form of treatment plants, and the rest in the form of distribution and collection systems (WSEB, 2005).[24] Over the next 15 years, the Province of Ontario's Ministry of Public Infrastructure Renewal (PIR) estimates that $34 billion will have to be invested in Ontario's water and wastewater systems, with $25 billion of this for capital renewal, and $9 billion to accommodate anticipated growth. The WSEP notes that "…unless the rate of capital investment increases sharply from the levels of the recent past, Ontario will face a gap of roughly $18 billion between what systems need and what they receive in funding over the next 15 years."[25]

Scenario #2: A large infrastructure project consisting of the $17.5 billion MoveOntario 2020 plan, and the required $34 billion in water and wastewater infrastructure expenditures.

2.3 Ontario's Power Generation and Distribution Systems

From the perspective of Ontario's long-term economic growth and development, perhaps no system is more fundamental than the power generation and distribution system. On August 29, 2007, the Ontario Power Authority (OPA) filed an application with the Ontario Energy Board (OEB) for the approval of the Integrated Power System Plan (IPSP). The IPSP is a response by the OPA to, what it calls "a looming supply gap" attributable to aging infrastructure, the retiring of power plants (e.g., coal-fired plants), and increasing demand. The OPA

[24] Ibid, p.7.
[25] Ibid, p.7-8.

notes that Ontario's electricity sector has less capacity presently than it did 12 years ago even in the face of increased demand stemming from population and economic growth. The OPA notes that this is especially true in downtown Toronto and the GTA generally where facilities have been shut down and where system load has grown more quickly than the provincial average. [26] The IPSP is a 20 year, $60 billion Integrated Power System plan that will set the direction for Ontario's electricity system through to the year 2027.

Table 1 shows current and future (via the IPSP) supply mixes for generation capacity and actual electricity production in the Province of Ontario in 2007 and at 2025. The $60 billion plan will significantly increase capacity and shift the overall supply mix toward renewables (e.g., hydroelectric, wind, biomass etc.) and, to a lesser extent, nuclear sources.

Table 1: Current Supply Mix for Electricity in the Province of Ontario[27]

	Installed Generation Capacity		Electricity Production	
Source	Percent of Total in 2007	Percent of Total in 2025	Percent of Total in 2007	Percent of Total in 2025
Renewables (Hydroelectric, wind, biomass etc.)	26.4%	37.0%	23.0%	43%
Nuclear	36.6%	35.0%	51.0%	50%
Coal	20.6%	0.0%	19.0%	0.0%
Gas/Oil	16.3%	27.0%	7.0%	6%
Total	100.0%	100.0%	100.0%	100.0%

Figure 2 shows that one of two possible IPSP system configurations (called Case 1A by OPA) would completely encompass the time period considered in this

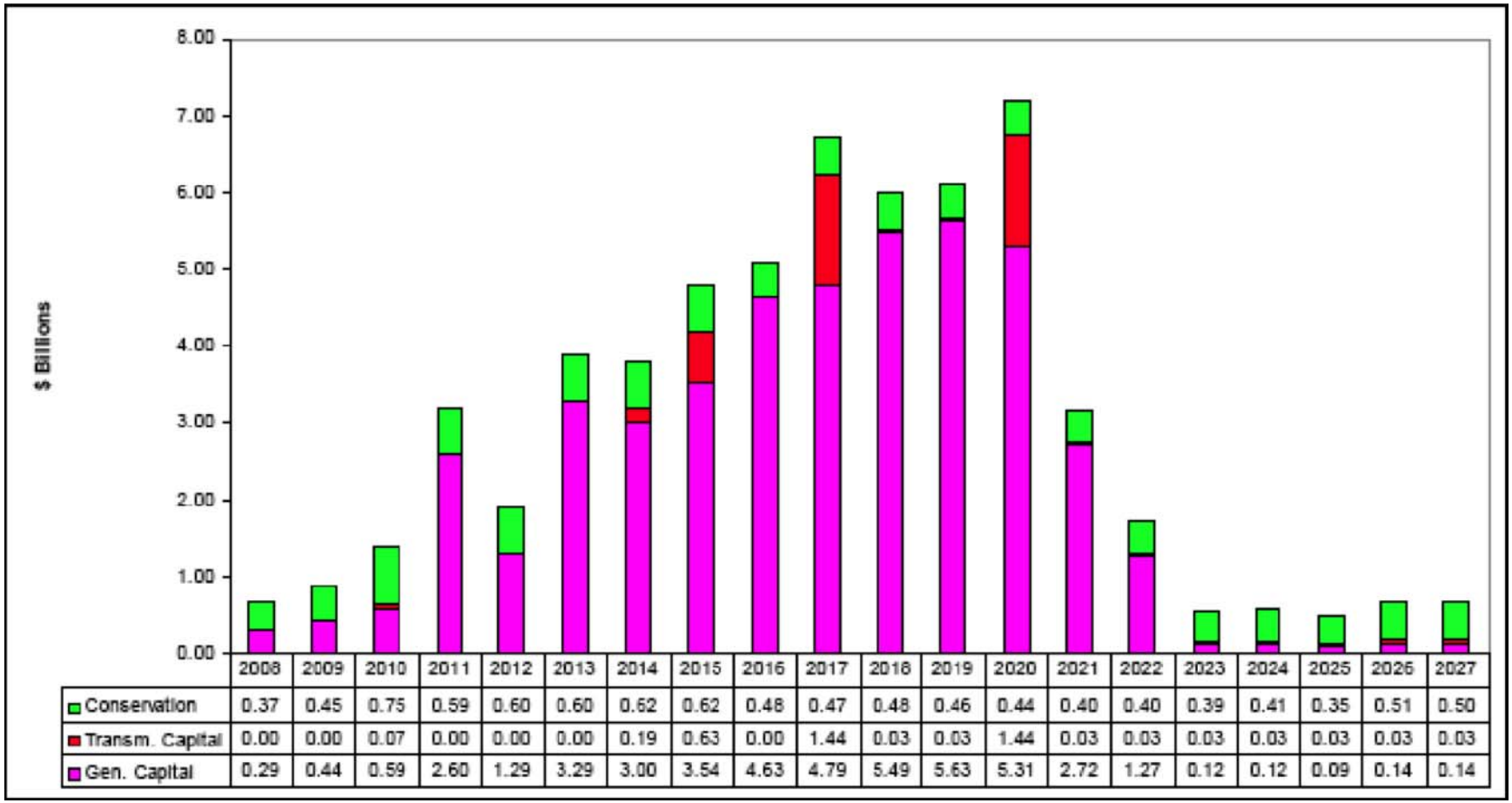
[26] http://www.powerauthority.on.ca/electron/Page.asp?PageID=1290&ContentID=666&SiteNodeID=141&BL_ExpandID=246 and http://www.powerauthority.on.ca/Page.asp?PageID=122&ContentID=1139&SiteNodeID=127&BL_ExpandID=

[27] ibid.

report (2008 to 2020). IPSP Case 1A includes the assumption that the Pickering B nuclear facility is refurbished and brought on-line in addition to other investments in generation and transmission capital. IPSP Case 1B is very similar to Case 1A (still amounting to approximately $60 billion) with the exception that Pickering B is not refurbished but rather replaced with gas-fired capacity in the interim until new nuclear capacity comes on-line in 2020. For the purposes of this report, the technical details of the IPSP are not central, but rather our focus is on the nature, magnitude and timing of the expenditures. Given that IPSP Case 1A and 1B are virtually indistinguishable on these dimensions, no further distinction will be made in this report, and reference will be made only to the IPSP. The third scenario to be examined therefore focuses on the implementation of the IPSP in Ontario over the period of this analysis (certainly leading up to, and possibly passing 2020).

Scenario #3: $60 billion Integrated Power System Plan for Ontario to be implemented over the period 2008/09 to 2027/28.

Figure 2: Annual Capital Expenditures for IPSP Case 1A (2007 $Billions)[28]



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Conservation	0.37	0.45	0.75	0.59	0.60	0.60	0.62	0.62	0.48	0.47	0.48	0.46	0.44	0.40	0.40	0.39	0.41	0.35	0.51	0.50
Transm. Capital	0.00	0.00	0.07	0.00	0.00	0.00	0.19	0.63	0.00	1.44	0.03	0.03	1.44	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Gen. Capital	0.29	0.44	0.59	2.60	1.29	3.29	3.00	3.54	4.63	4.79	5.49	5.63	5.31	2.72	1.27	0.12	0.12	0.09	0.14	0.14

[28] Source: OPA (2007). "Plan Cost EB-2007-0707 Exhibit G, Tab 2, Schedule 1.

2.4 Ontario's Motor Vehicle Manufacturing Industry

An issue that has been simmering in Ontario for decades, if not a century, relates to the prospects for the province's manufacturing sector. As noted above, Ontario is the manufacturing heart of Canada, and given this specialization, the province is susceptible to periods of declining demand for manufactured products, most often triggered by periods of economic recession in the US. We are now into such a phase – our principal market for manufactured goods (the US) is going through a period of unprecedented economic turmoil and, as a result, global demand for Ontario's principal products, durable and semi-durable manufactured goods, is declining. For this reason, a fourth and final scenario will consider the impact on the provincial economy of a 50 percent reduction in total demand for the output of Ontario's "Motor Vehicle Manufacturing" industry.

Scenario #4: A 50 percent decrease in the final demand for the output of Ontario's "Motor Vehicle Manufacturing" industry.

While it is true that the infrastructure scenarios discussed above do not represent on-going expenditures in perpetuity, they will likely all be active in the Province for the duration of the study period – 2008 to 2020. As such, over this period of time, the cumulative effect of these projects will become the normal background noise of the economy. Once these projects are all completed and the investments associated with them cease, the assumption is that overall activity levels or expenditure levels will not decline, but rather increase, as ever more important uses for public monies are revealed. The move toward compact cities with integrated sustainable transportation and utility systems is becoming imminent, and this will require the investment of tens, if not hundreds, of billions of public dollars beyond 2020. The main objective of this report is to produce plausible pictures of the Ontario economy in 2020, and it is to this that we now turn.

3.0 Projection Methodology

As noted above, the primary purpose of this analysis is to produce plausible projections of the size and nature of the Ontario economy in 2020. The first step in developing these projections is to fashion scenarios for Ontario relating to the large and pervasive trends and events that we can foresee. In their long-range projections, the Ontario Ministry of Finance (2005) made use of this approach and focused on key demographic and productivity trends. Our approach will be similar, and will focus on four broadly defined scenarios of large-scale macro changes that could take place in the Province by 2020.[29] The impacts discussed herein must be interpreted as being "shocks" or perturbations in relation to an overall level of background economic activity which, for ease of argument, can be considered to be an extrapolation of GDP from 2004 to 2020 using Conference Board of Canada projected growth rates over the long run.

Our analysis aims to translate the aforementioned scenarios into a series of parametric changes in the balance equations that essentially describe how each sector of the provincial economy is interconnected (as a buyer and seller of products) with other industries in the economy. Typically, economic impact analyses produce estimates of the total impacts (including direct, indirect and induced effects) on gross industry output, GDP, and employment. While the model employed in this analysis will compute total impacts in this way, it will go further to express the total employment impact in occupation-specific terms. Much has been written about the correlation between the presence of knowledge and otherwise "skilled" workers in a regional economy and its overall health, and about how a dearth of this input can act as a constraint on economic growth. In keeping with this, each scenario discussed above will be evaluated in terms of not only the industrial response to the scenarios, but also in terms of the occupational distribution of likely employment impacts of each scenario. This will

[29] The reader will notice that the economy-wide projections cover the period from 2004 to 2020 as opposed to starting in 2008. This is due to the fact that the most recent IO data for Canada and Ontario, upon which the model is based, pertains to 2004. As such, all projections start at 2004 and project out 16 years to 2020.

allow each scenario to be interpreted not only terms of which industries are likely to be growing or declining in these alternate pictures of the future Ontario, but also which types of labour (e.g., highly skilled, lower skilled, unskilled) are likely to become more or less in demand as a result.

3.1 Establishing the Background Growth Trend for the Province

The rate of economic growth to be experienced in Ontario over the long run has been projected by several reputable groups (e.g., The Conference Board of Canada, the Ontario Ministry of Finance, etc.). The Ontario Ministry of Finance (2005), in their long-range projection of the provincial economy, assumed the following base-case growth trajectory for the provincial economy over the period from 2005 to 2025:

Table 2: Ontario Ministry of Finance Base-Case Growth Trajectory for the Province out to 2025[30]

	2005-09	2010-14	2015-19	2020-25
Real GDP Growth (%)	2.9	3.0	2.6	2.3

The Ministry of Finance (2005) long-term outlook for Ontario served as the baseline for our analysis. All scenarios will be compared to this baseline. The actual baseline projection will be created by using these growth rates to compute an average annual compound rate of growth for provincial GDP, and then using this rate to extrapolate both GDP and Gross Output from 2004 (the last for which survey-based data is available) to 2020.

[30] Ontario Ministry of Finance (2005). "Toward 2025: Assessing Ontario's Long-Term Outlook." http://www.fin.gov.on.ca/english/economy/ltr/2005/05_ltr.html

3.2 Estimating the Industry-specific Impacts of Various Scenarios

The impacts of the scenarios discussed above were estimated using a highly detailed synthetic Input-Output (IO) model of the provincial economy. Given that the scenarios involved specific sectors of the economy, and specific sub-sectors (e.g., coal-fired electricity plants versus natural gas-fired plants, coal mining versus natural gas production etc.) a high degree of industry detail in the impact model was considered to be essential to the fruitful completion of this project. For similar reasons, given the IO model's focus on detailed intersectoral relationships, and their relationship to exogenous variables, the IO modeling framework coupled with a very detailed IO database was thought to represent a reasonable approach to projecting economic activity in Ontario out to 2020.[31]

The Input-Output Division of Statistics Canada publishes survey based IO accounts at the national and provincial scales on an annual basis. The most current year presently available is 2004. In addition to the inherent lag involved with the use of IO data in Canada, provincial IO data is only published at a very aggregate level of industry detail known as the "Small" or "S" level. The S-level provides detailed information on the economic transactions taking place between 25 aggregate industry groups. This level of detail (for example, with one construction industry and only one manufacturing industry) was deemed to be too coarse for this analysis. More detailed IO tables are available in Canada, but only for the nation as a whole. Given the nature of the scenarios discussed above, and to provide maximum flexibility in the implementation of these scenarios, the decision was made to use the "Link" (or L) level national IO tables as the basis for a synthetic IO model of the Ontario economy at the L-level of industry aggregation (105 industries). Regionalization techniques were used to develop a

[31] It should be noted here that IO analysis is not ideally suited to the examination of long-term trends because of the model's reliance on static technical coefficients and its inability to accommodate increasing returns to scale in production functions. While these caveats are well founded and duly noted, the fact remains that, in practice, measureable structural change in aggregate IO data (to the extent that it would obviate results) takes extremely long periods of time to become significant. As well, the technique does offer the user the opportunity to adjust coefficients to examine the effect of changes in input mixes.

synthetic (i.e., non-survey based) IO table for the Province of Ontario for 2004 at the L-level using the 2004 national L-level tables as the basis. Information relating to structural differences between the provincial and national economies was used to "regionalize" the national IO table. The final form of the model is as follows (n=105):

Equation 1:

$$\Delta \dot{X}^{ON} = \left(I - \hat{\Omega}\hat{\Phi}\right)^{-1} \cdot \Delta \dot{Y}^{ON}$$

where;

Equation 2:

$$\Delta \dot{X} = \begin{bmatrix} \\ \Delta x_1^{ON} \\ \Delta x_2^{ON} \\ \Delta x_3^{ON} \\ \vdots \\ \Delta x_n^{ON} \\ \Delta x_h^{ON} \end{bmatrix}; \Delta \dot{Y}^{ON} = \begin{bmatrix} \\ \Delta y_1^{ON} \\ \Delta y_2^{ON} \\ \Delta y_3^{ON} \\ \vdots \\ \Delta y_n^{ON} \\ \Delta y_h^{ON} \end{bmatrix}$$

and where;

Equation 3:

$$\hat{\Phi} = \begin{pmatrix} \phi_1 & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & \phi_n \end{pmatrix}$$

and where;

Equation 4:

$$\Omega = \begin{pmatrix} \omega_{11} & \cdots & \omega_{1n} \\ \vdots & \ddots & \vdots \\ \omega_{n1} & \cdots & \omega_{nn} \end{pmatrix}$$

and where;

Equation 5:

$$\phi_i = \left(\frac{\frac{e_i^{ON}}{\sum_i e_i^{ON}}}{\frac{e_i^{CAN}}{\sum_i e_i^{CAN}}} \right)$$

and where;

Equation 6:

$$\omega_{ij} = \left[1 \quad \left(\frac{M_{ij}}{D_{ij}} \right) \right]$$

and where;

Equation 7:

$$D_i = X_i - E_i + M_i$$

In Equations 1 through 9:

X denotes industry gross output;
Y denotes industry final demand;
M denotes imports;
e denotes employment;
i and j represent industries where I is typically a row (selling) industry and j is typically a column (purchasing) industry;
ϕ denotes an employment-based index of relative specialization;
Φ is a diagonal matrix of ϕ's;
ω denotes a domestic production share;
Ω is a matrix of ω's
l typically denotes occupations;
V denotes total employment;
E denotes exports; and,
D denotes "domestic availability".

The IO model shown above in equation 1 is a synthetic model of the Ontario economy in that it is not based on IO data for Ontario. Instead, the model is based on a set of national coefficient matrices which are weighted using various measures to make them more closely reflect the nature of the provincial economy, as opposed to the national economy.

The model shown in equation 1 takes as input a given exogenous shock in the level of demand for any of 105 industry groups, and generates an associated impact vector (□X) showing the total economic impact (over 105 industry groups in this instance). The model shown in equation 1 was also designed to treat personal consumption expenditures endogenously thereby facilitating a link between inter-industry activity levels, payments to labour (i.e., the household sector), personal consumption expenditures and further industrial output – the induced effect.

3.3 Estimating the Occupation-Specific Employment Impacts of Growth/Change Scenarios

While the total employment impact associated with a given shock to the economy is a very useful, and often sought after piece of information. Even more useful is information on the exact nature of this employment impact (e.g., x engineers, z managers, q nurses etc.). Clearly the occupational composition of the labour demand shock is far more useful and broadly applicable than is a single number of newly created jobs. This becomes even more true in the context of potential supply constraints on key inputs such as labour (or, more likely, skilled labour). Indeed, one of the scenarios discussed above relates to the potential economic impact to Ontario of a deficit of skilled labourers in the manufacturing sector. The demographic and occupational composition of the province's labour force has much to do with its long-term economic growth and development since these issues play key roles in the locational decision-making processes of firms (and workers). From an intra-provincial perspective, the spatial distribution of employment and the spatial distribution of appropriately skilled labour has much to do with the determination of commuting patterns and the demand for new transportation systems. In light of this, all scenarios discussed above will be examined in terms of their impact on the demand for labour in Ontario on an occupationally specific basis.

The estimation of occupation-specific employment impacts for any run of the impact model discussed above is made possible via by a matrix of occupation-

and industry-specific employment multipliers computed from a custom cross-tabulation of the employed labour force in Ontario by detailed industries (4 digit NAICS) and detailed occupations (4 digit NOCS). The occupation specific employment multipliers are defined as follows:

Equation 8:

$$r_i = \frac{V_i}{X}$$

Equation 8 therefore denotes a linear employment multiplier that is specific to individual industries. Any industry output information (e.g., such as that flowing from a growth/change scenario) can be transformed into a projection of the demand for specific types of labour. The impact model presented in equation 1 above is easily married with this a matrix of occupation-specific employment multipliers to form an employment projection model which is capable of disaggregating the employment impacts stemming from a given shock or change into occupation-specific demand estimates. The employment projection formulation can be expressed as follows:

Equation 9:

$$\Delta V = E\left[(I \quad \Delta b_{ij})^{-1} \Delta Y\right]$$

where;

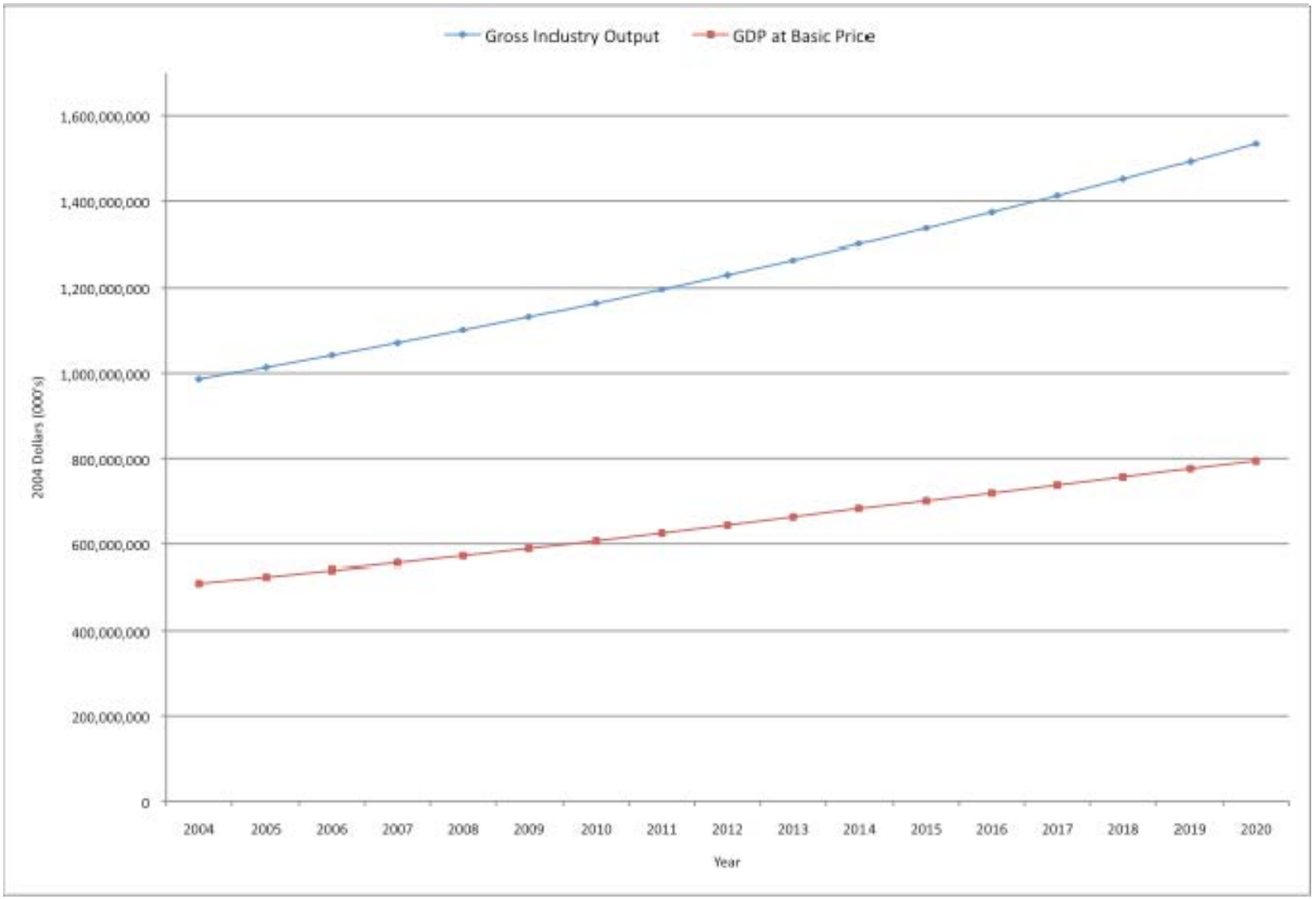
$$E = [r_{ij}]$$

Matrix E has l rows (determined by the number of occupational groups to be used) and n columns (determined by the number of industries in the IO model). For each of 105 L-level industries (n) in Ontario, under each scenario, employment impacts are computed for 26 (l) NOC Major Groups (i.e., two digit NOCs). The actual NOCS major groups and NAICS industries are listed in the Appendix.

4.0 Examining the Industrial and Occupational Implications of the Growth/Change Scenarios for Ontario out to 2020

For each of the growth/change scenarios, information on expenditures and/or gains/losses had to be translated into terms palatable by the IO model. In other words, the expenditures discussed in the scenarios had to be allocated to specific industries in the synthetic IO database. Indeed, it was this process which called for the use of very disaggregate IO data to allow for some degree of precision in the way in which the scenarios are impressed upon the model. For example, if all of construction activity in Ontario is summed to one "Construction" aggregate, then there is no way to distinguish between the building of a major power infrastructure project (which would consist primarily of government and private sector investment expenditures) from the building of a residential subdivision (which would consist of personal investment expenditures).

Figure 3: Linear Projection of Gross Industry Output and GDP in Ontario, 2004-2020



As noted above, our intention is to examine the impact of these scenarios over and above the presumed trend of gradual GDP growth in Ontario. It is important to note that what follows cannot be considered a forecast, but rather a projection. We make no claims to being able to foretell the future, but rather we are attempting to show plausible pictures of what Ontario *could* look like in 2020. Clearly, there could be significant fluctuations between 2004 and 2020 that are not accounted for by the model – it is our contention that the moving average path from 2004 values to 2020 values is a reasonably conservative projection of the future course of the provincial economy based on past performance and expert judgment regarding Ontario's future (see Table 2 above).

4.1 Establishing the Base-Line Projection to 2020

The base-line projection was computed by running estimated 2004 total final demand values for Ontario (L-level final demands) through the model to estimate the total gross output of all L-level industries in 2004. These values, based on the 2004 interindustry structure that is embedded in the synthetic model represent a plausible estimate of the structure of the Ontario economy in 2004. As such, these initial total gross output values across all L-level industries in Ontario represents the starting point for all projections developed in this report.

The growth rates shown in Table 2 were used to develop a linear projection of total gross industry output and Gross Domestic Product (GDP) at basic prices for 105 industries in Ontario from 2004 (the base year for the IO data and the most recent available) to 2020. The extrapolation shown in Figure 3 was obtained by computing a compound average annual rate of growth from the Ministry of Finance growth estimates shown in Table 2, and using this to extend the series out to 2020.The gradual but steady upward trend in provincial economic activity is not based on ignorance of the fact that the future for the province is likely to be far less smooth than what is seen here, but rather on the notion that over this period of time, the average trend will, in all probability, be similar that shown in

Figure 3. The information used to compute the output and GDP projections in Figure 3 was aggregated from an initial run of the IO model. The actual run shows output and GDP values across 105 industries in Ontario.

The base-line output values shown in Figure 3 can be used to compute the associated employment requirements, by specific occupational groups, as shown above in Equation 9. Figure 4 presents the projected baseline employment levels by occupation out to 2020. Tables 3 and 4 present the information displayed in Figure 4 sorted in two different ways. Table 3 ranks employment by occupation, in descending order, by percentage change over 2001 values. Those occupational groups which are projected, in the base-line scenario, to experience the greatest percentage change by 2020 (relative to census counts in 2001) include:

- Skilled Occupations in Primary Industry (178%)
- Intermediate Occupations in Primary Industry (147%);
- Assisting Occupations in Support of Health Services (102%);
- Technical and Skilled Occupations in Health (88%); and,
- Paraprofessional Occupations in Law, Social Sciences, Education and Religion (78%).

Table 3 also shows that relative to 2001 (the year for which the detailed employment by occupation data is available), total employment in the Province of Ontario, following the baseline scenario, could increase by 62 percent by 2020. Figure 4 shows that this growth will not be confined one or even a few industries, but rather be spread across all 26 occupation groups shown in Figure 4. Indeed, none of the 26 occupational groups shown in Table 3 are projected to increase by less than 25 percent over the period, and the demand for most occupations is projected to increase by more than 50 percent. The average rate of growth in demand across all occupations shown in Table 3 is 70 percent.

Table 4 sorts employment by occupation by the absolute value of projected 2020 levels, in descending order. Those occupations projected, under the base-line scenario, to experience the largest absolute change over the period include:

- Intermediate Sales and Service Occupations (66%);
- Clerical Occupations (59%);
- Middle and Other Management Occupations (52%);
- Elemental Sales and Service Occupations (64%); and,
- Trades and Skilled Transport and Equipment Operators (67%).

Figure 4: Baseline Projection of Employment by Occupation to 2020, Ontario

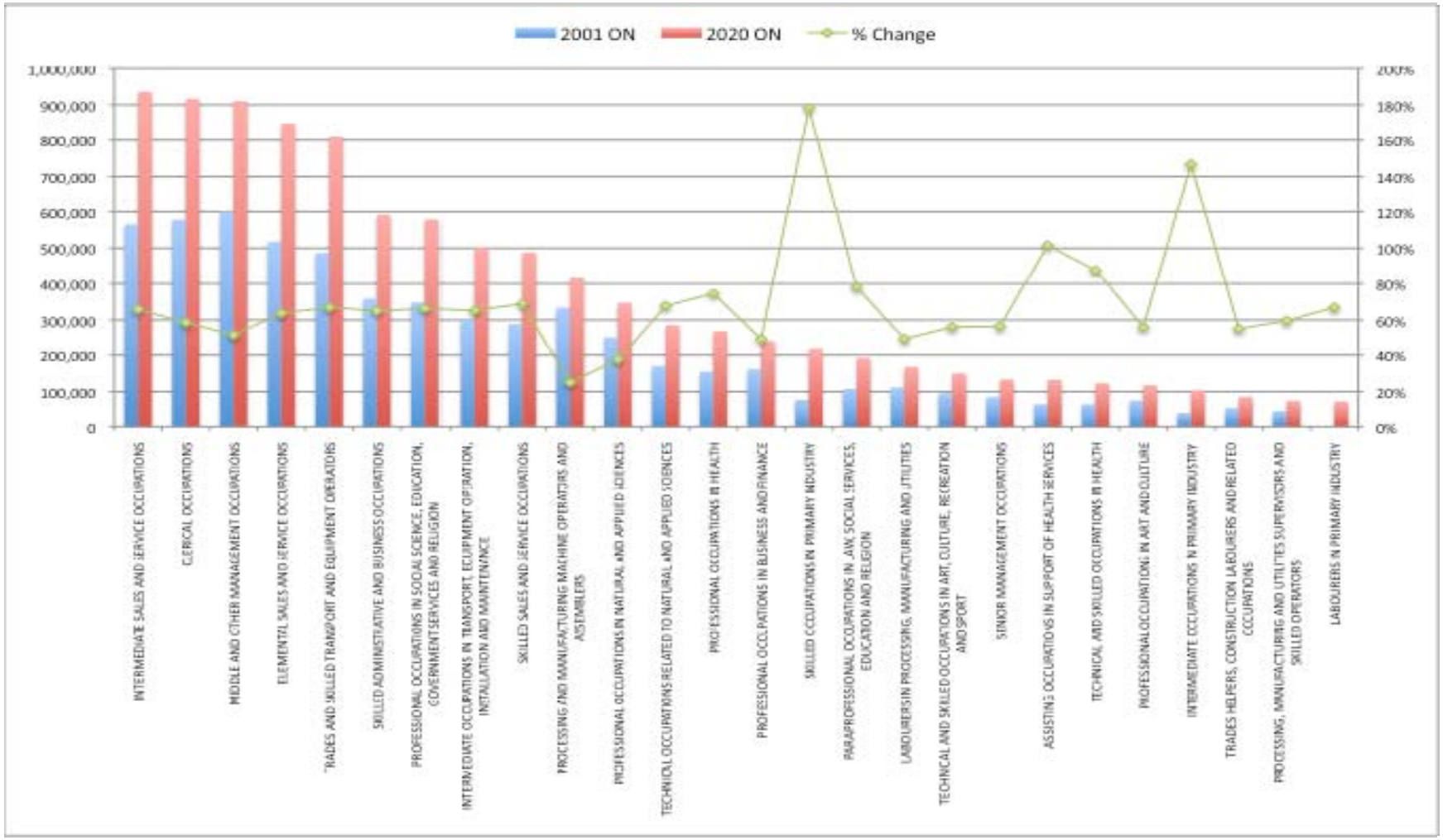


Table 3: Employment Projections to 2020 by Occupation, Ontario (sorted on percentage change)

NOCS	2001 ON	2020 ON	% Change
SKILLED OCCUPATIONS IN PRIMARY INDUSTRY	77,985	216,972	178%
INTERMEDIATE OCCUPATIONS IN PRIMARY INDUSTRY	42,260	104,290	147%
ASSISTING OCCUPATIONS IN SUPPORT OF HEALTH SERVICES	86,020	173,072	102%
TECHNICAL AND SKILLED OCCUPATIONS IN HEALTH	89,670	173,345	93%
PARAPROFESSIONAL OCCUPATIONS IN LAW, SOCIAL SERVICES, EDUCATION AND RELIGION	107,790	191,897	78%
PROFESSIONAL OCCUPATIONS IN HEALTH	154,365	269,770	75%
SKILLED SALES AND SERVICE OCCUPATIONS	268,635	452,700	69%
TECHNICAL OCCUPATIONS RELATED TO NATURAL AND APPLIED SCIENCES	170,165	285,490	68%
LABOURERS IN PRIMARY INDUSTRY	44,120	73,831	67%
TRADES AND SKILLED TRANSPORT AND EQUIPMENT OPERATORS	487,095	812,572	67%
PROFESSIONAL OCCUPATIONS IN SOCIAL SCIENCE, EDUCATION, GOVERNMENT SERVICES AND RELIGION	348,060	578,942	66%
INTERMEDIATE SALES AND SERVICE OCCUPATIONS	584,550	970,054	66%
INTERMEDIATE OCCUPATIONS IN TRANSPORT, EQUIPMENT OPERATION, INSTALLATION AND MAINTENANCE	327,575	540,011	65%
SKILLED ADMINISTRATIVE AND BUSINESS OCCUPATIONS	358,110	591,142	65%
ELEMENTAL SALES AND SERVICE OCCUPATIONS	518,090	849,477	64%
PROCESSING, MANUFACTURING AND UTILITIES SUPERVISORS AND SKILLED OPERATORS	47,066	75,173	60%
CLERICAL OCCUPATIONS	578,080	916,475	59%
SENIOR MANAGEMENT OCCUPATIONS	85,615	134,080	57%
TECHNICAL AND SKILLED OCCUPATIONS IN ART, CULTURE, RECREATION AND SPORT	96,315	150,370	56%
PROFESSIONAL OCCUPATIONS IN ART AND CULTURE	75,345	117,552	56%
TRADES HELPERS, CONSTRUCTION LABOURERS AND RELATED OCCUPATIONS	55,450	86,023	55%
MIDDLE AND OTHER MANAGEMENT OCCUPATIONS	599,785	910,308	52%
LABOURERS IN PROCESSING, MANUFACTURING AND UTILITIES	111,770	167,331	50%
PROFESSIONAL OCCUPATIONS IN BUSINESS AND FINANCE	161,780	241,948	50%
PROFESSIONAL OCCUPATIONS IN NATURAL AND APPLIED SCIENCES	251,360	347,438	38%
PROCESSING AND MANUFACTURING MACHINE OPERATORS AND ASSEMBLERS	323,460	416,857	29%
Total Employment	5,992,755	9,717,367	62%

Table 4: Employment Projections to 2020 by Occupation, Ontario (sorted on 2020 ON values)

NOCS	2001 ON	2020 ON	% Change
INTERMEDIATE SALES AND SERVICE OCCUPATIONS	584,330	936,064	60%
CLERICAL OCCUPATIONS	578,020	916,425	59%
MIDDLE AND OTHER MANAGEMENT OCCUPATIONS	599,785	918,308	53%
ELEMENTAL SALES AND SERVICE OCCUPATIONS	518,090	848,437	64%
TRADES AND SKILLED TRANSPORT AND EQUIPMENT OPERATORS	487,085	812,832	67%
SKILLED ADMINISTRATIVE AND BUSINESS OCCUPATIONS	358,110	591,142	65%
PROFESSIONAL OCCUPATIONS IN SOCIAL SCIENCE, EDUCATION, GOVERNMENT SERVICES AND RELIGION	348,060	575,942	66%
INTERMEDIATE OCCUPATIONS IN TRANSPORT, EQUIPMENT OPERATION, INSTALLATION AND MAINTENANCE	382,975	560,011	46%
SKILLED SALES AND SERVICE OCCUPATIONS	288,635	481,708	67%
PROCESSING AND MANUFACTURING MACHINE OPERATORS AND ASSEMBLERS	332,460	416,837	25%
PROFESSIONAL OCCUPATIONS IN NATURAL AND APPLIED SCIENCES	272,360	347,438	28%
TECHNICAL OCCUPATIONS RELATED TO NATURAL AND APPLIED SCIENCES	178,165	283,498	60%
PROFESSIONAL OCCUPATIONS IN HEALTH	154,965	268,770	73%
PROFESSIONAL OCCUPATIONS IN BUSINESS AND FINANCE	161,780	241,948	50%
SKILLED OCCUPATIONS IN PRIMARY INDUSTRY	77,985	216,972	178%
PARAPROFESSIONAL OCCUPATIONS IN LAW, SOCIAL SERVICES, EDUCATION AND RELIGION	107,780	191,857	78%
LABOURERS IN PROCESSING, MANUFACTURING AND UTILITIES	111,770	167,731	50%
TECHNICAL AND SKILLED OCCUPATIONS IN ART, CULTURE, RECREATION AND SPORT	100,315	155,378	55%
SENIOR MANAGEMENT OCCUPATIONS	85,615	134,080	57%
ASSISTING OCCUPATIONS IN SUPPORT OF HEALTH SERVICES	60,890	123,074	103%
TECHNICAL AND SKILLED OCCUPATIONS IN HEALTH	65,670	123,345	88%
PROFESSIONAL OCCUPATIONS IN ART AND CULTURE	75,945	117,852	55%
INTERMEDIATE OCCUPATIONS IN PRIMARY INDUSTRY	42,260	104,290	147%
TRADES HELPERS, CONSTRUCTION LABOURERS AND RELATED OCCUPATIONS	55,450	85,023	53%
PROCESSING, MANUFACTURING AND UTILITIES SUPERVISORS AND SKILLED OPERATORS	47,865	75,171	60%
LABOURERS IN PRIMARY INDUSTRY	44,120	71,651	62%
Total Employment	5,992,759	9,717,387	62%

Table 5: Scenarios to be Evaluated

Name	Description	Effect
Baseline	Linear extrapolation of 2004 Gross Output and GDP to 2020 using the long range outlook produced by the Ontario Ministry of Finance (2005)	
Scenario 1 (SC1)	Skilled labour shortage in Ontario – a shortfall of 100,000 skilled workers in manufacturing over next 15 years.	$40 billion in lost manufacturing output over the period.
Scenario 2 (SC2)	Combination of remaining MoveOntario 2020 transportation investments and remaining water and wastewater infrastructure investments in ReNew Ontario over the next 10 to 20 years.	$17.5 billion for MoveOntario. $34 billion for water and wastewater. Total expenditures pf $51.5 billion.
Scenario 3 (SC3)	Implementation of the Ontario Power Authority's Integrated Power System Plan (IPSP) which went to the OEB in 2007.	$60 billion
Scenario 4 (SC4)	50 percent drop in the demand for motor vehicles produced in Ontario	$14.8 billion

4.2 Scenario #1 (SC1): Loss of 100,000 skilled workers in the manufacturing sector and a consequent loss of $40 billion in manufacturing output over the period from 2008 to 2020

As discussed above, the first scenario to be evaluated and compared to the baseline paints a rather bleak image of what the Ontario economy could look like in 2020. This scenario is fashioned from many projections of the population and the labour force in Ontario which all point to the fact that a slowing rate of growth, coupled with a rapidly aging population and declining fertility rates stands to have a significant impact on the supply of labour in the province in very near term. Indeed, the Conference Board of Canada (2007) notes that by as early

as 2014, the demand for labour in Ontario could outstrip supply. The fact that projections suggest that this shortfall could be especially serious in the skilled occupations, primarily in the manufacturing sector, makes this trend that much more alarming. The first scenario to be evaluated below is based on a study completed by the Ontario Chamber of Commerce in 2006. The study posits a shortfall of 100,000 manufacturing workers and a consequent loss of $40 billion in manufacturing output over the next 15 years. Figure 5 presents the aggregate effect of this scenario, along with that of the baseline and other scenarios to be discussed below.

Relative to the baseline projection, Figure 5 shows that the 100,000 skilled worker shortfall in manufacturing industries, and the consequent loss of $40 billion in manufacturing output over the period, would have a devastating impact on the provincial economy. Specifically, the loss of 100,000 skilled workers in the manufacturing sector translates into $40 billion in lost manufacturing output over the period, and to an economy-wide loss of nearly $115 billion across all industrial sectors in the province over the period.

Figure 5: Projection Summary

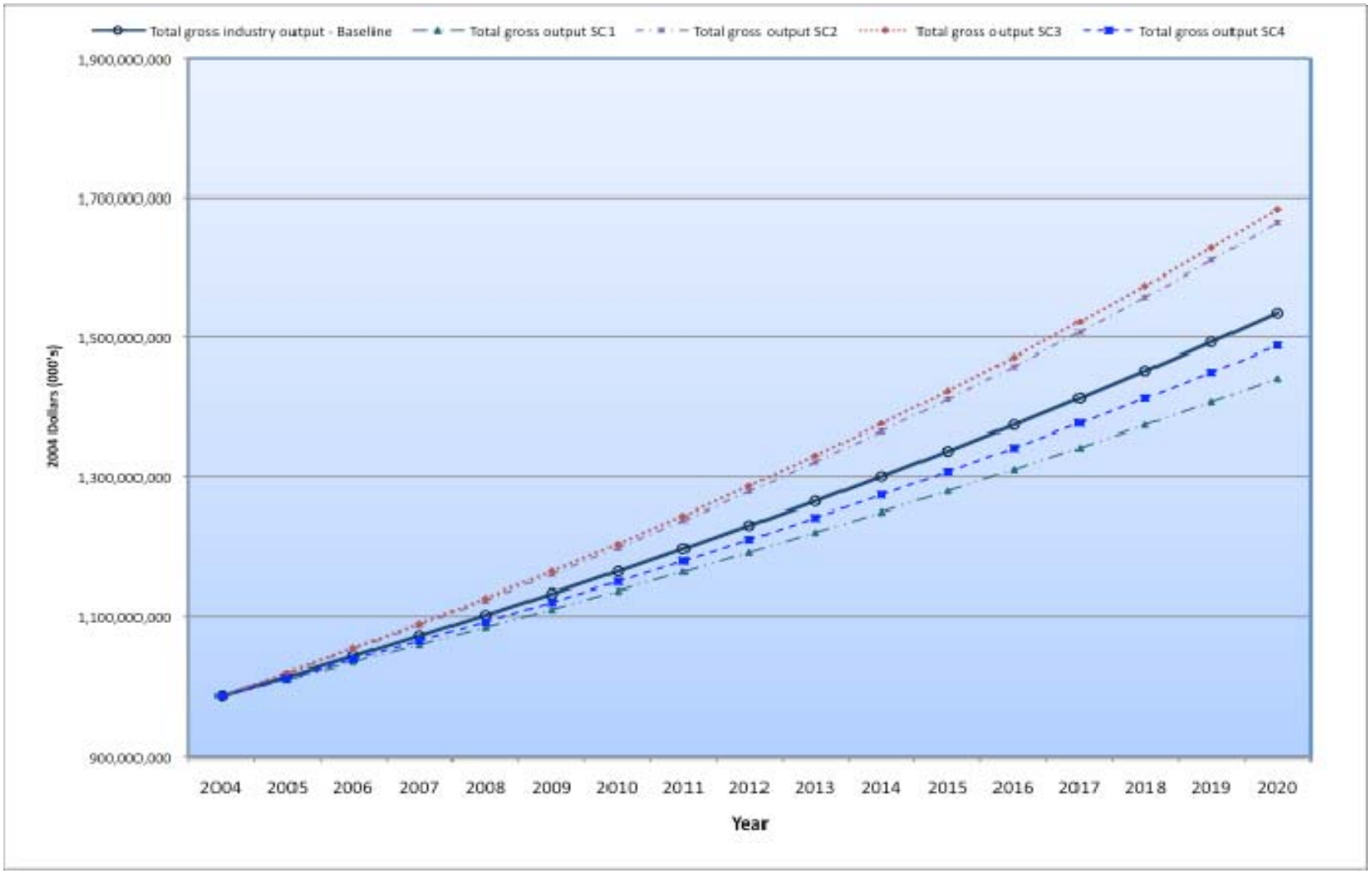


Figure 6: Industry Output Impacts, 2004-2020, Scenario 1 (Top 30 Industries Only)

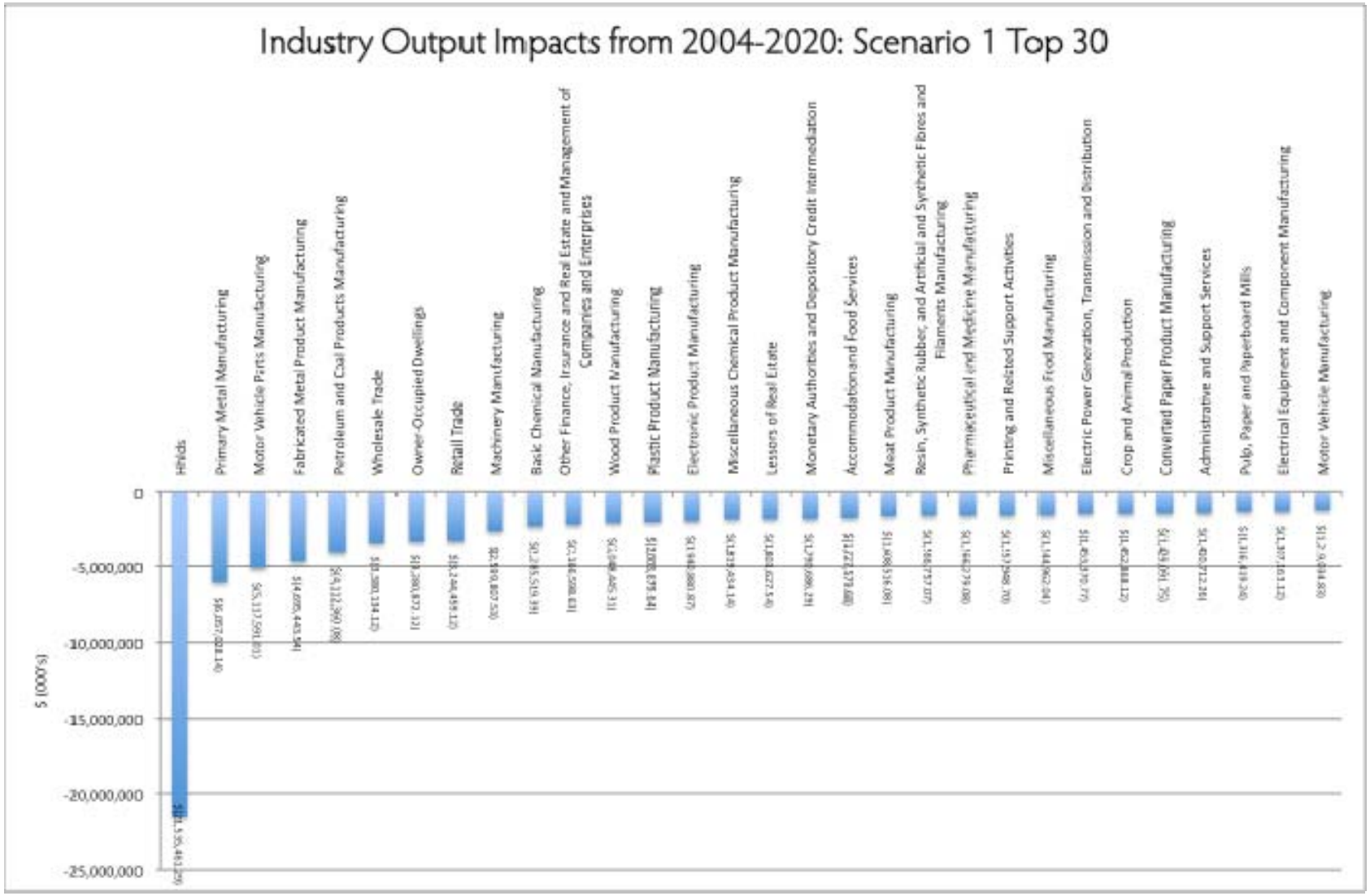


Figure 7: Occupation-specific Employment Impact of SC1

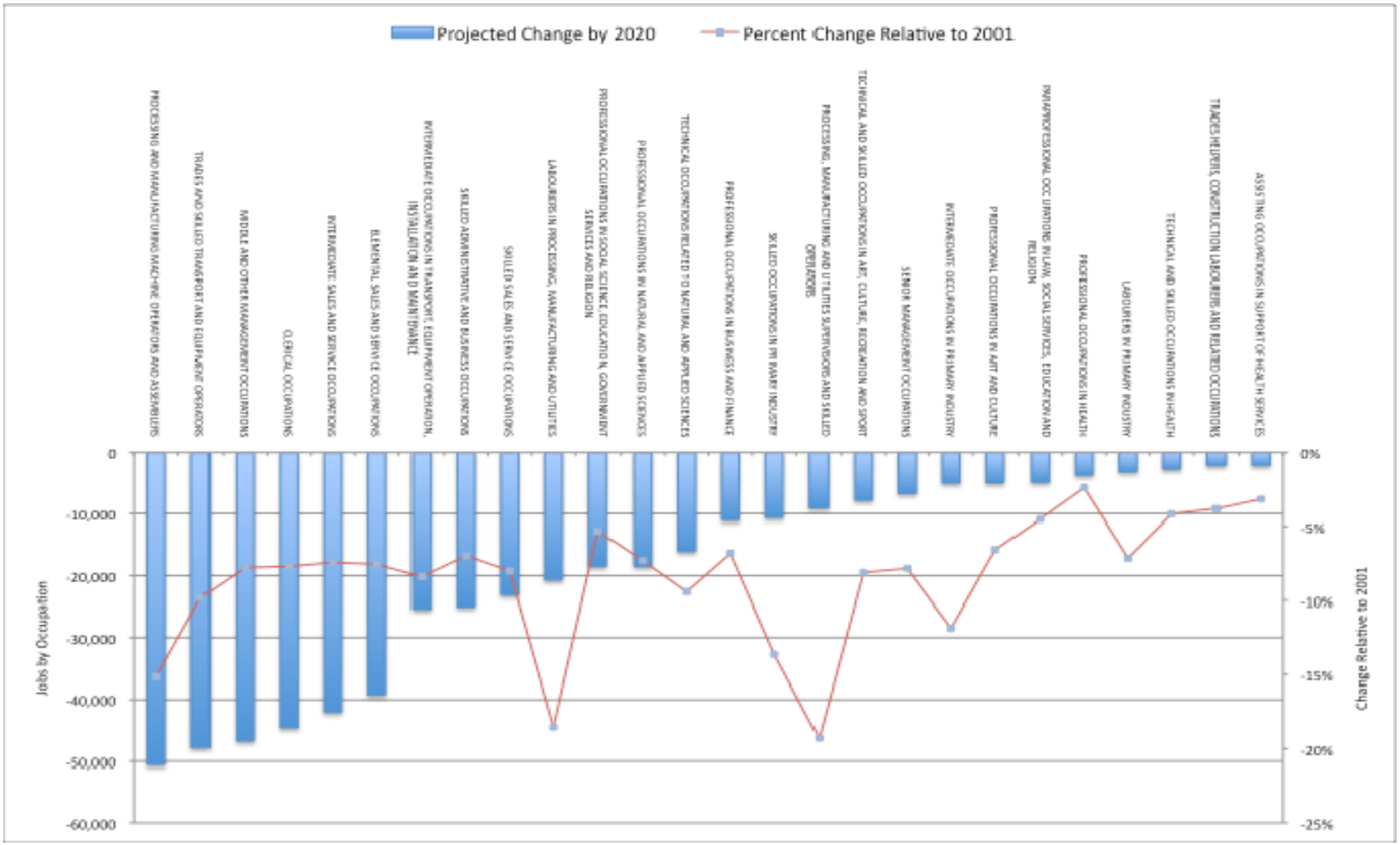


Figure 6 shows the industrial impacts of SC1 on the top 30 industrial categories in Ontario in terms of the magnitude of the impact experienced under this scenario. Figure 6 shows that the total output impact in Ontario over the period will be felt most strongly across all manufacturing categories (not surprisingly given that this scenario focuses on the manufacturing sector). Figure 7 shows that this scenario will also, as one would expect, have a drastic impact on provincial employment levels across all occupations. Specifically, the loss of $40 billion in manufacturing output over the period (initiated by a shortfall of 100,000 skilled workers in the manufacturing industry) leads, through direct, indirect and induced effects, to an economy-wide employment loss of more than 492,000 jobs across all occupations in the Province over the period (relative to the baseline). Figure 7 shows that this dramatic employment loss will be concentrated in the highly skilled trades including:

- Processing and manufacturing machine operators and assemblers (-50,562 positions);
- Trades and skilled transport and equipment operators (-47,837 positions);

as well as in several of the middle echelon of the white-collar occupations including;

- Middle and Other Management Occupations (-46,742 positions);
- Clerical Occupations (-44,590 positions); and,
- Intermediate Sales and Service Occupations (-42,025)..

Figure 7 also shows that those occupational groups to see the largest percentage change over the period, include:

- Processing and manufacturing machine operators and assemblers (-59%);
- Skilled sales and service occupations (-35%);
- Labourers in processing, manufacturing and utilities (-31%);
- Middle and other management occupations (-29%); and,
- Technical occupations related to natural and applied sciences (-21%).

4.3 Scenario 2 (SC2): The combined effect of the Province's MoveOntario 2020 project ($17.5 billion) and the water and wastewater infrastructure plans that remain in the RenewOntario plan ($34 billion).

The total expenditure for this scenario is $51.5 billion and it will be allocated to industrial sectors ranging from "Non-residential Building and Engineering Construction" to "Railroad Rolling Stock Manufacturing", and "Motor Vehicle Body and Trailer Manufacturing" to high-level services including "Computer Systems Design and Other Professional, Scientific and Technical Services". The total impact of the $51.5 billion shock over the period from 2004 to 2020 is nearly $130 billion (or $165 billion if labour income impacts – those which drive the induced impacts – are included). Figure 5 shows that scenario 2 (SC2) lies well above the baseline for all years in the period, showing somewhat accelerated growth over time relative to the baseline. SC2 is clearly an expansionary scenario which would undoubtedly produce a very different Ontario than would the contractionary scenario, SC1.

Figure 8 presents the total impacts associated with SC2 for the 30 most impacted industries in Ontario. Not unexpectedly, given that so much of this scenario involves very large engineering construction, the largest impact (direct, indirect and induced) is felt by the "Non-residential Building and Engineering Construction" industry ($46 billion). The top five industrial categories in terms of the impacts of SC2 include:

- Non-residential building and engineering construction (with more than 35% of the total industrial impact);
- Owner-occupied dwellings;
- Retail trade;
- Legal, Accounting and Architectural, Engineering and Related Services; and,
- Wholesale Trade.

Figure 8:

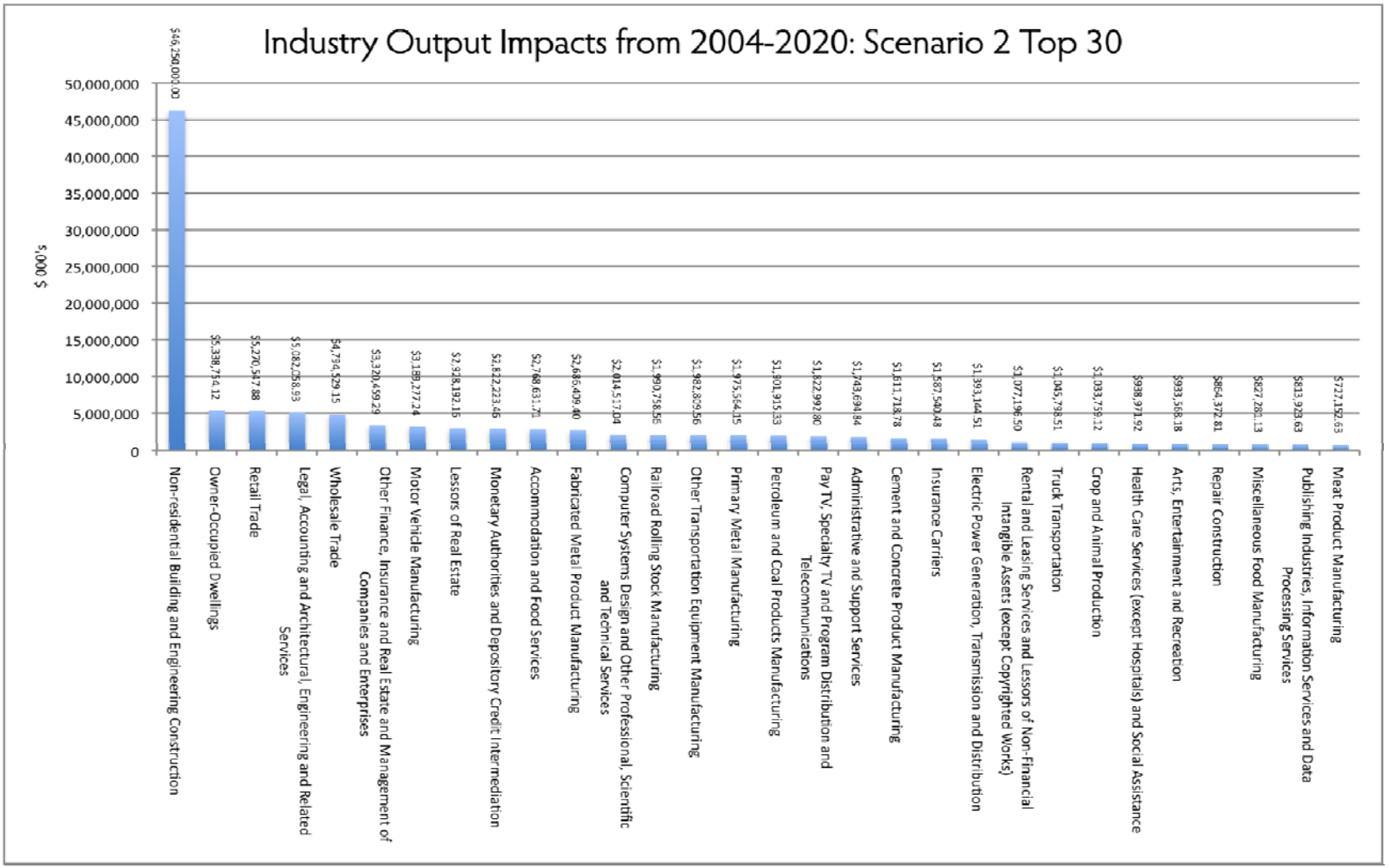

Industry Output Impacts from 2004-2020: Scenario 2 Top 30
$ 000's
50,000,000
45,000,000
40,000,000
35,000,000
30,000,000
25,000,000
20,000,000
15,000,000
10,000,000
5,000,000
0
$46,250,001.00
$5,338,754.12
$5,270,547.88
$5,082,758.93
$4,794,529.15
$3,320,459.29
$3,189,277.24
$2,938,192.16
$2,822,223.46
$2,768,631.71
$2,686,409.40
$2,014,517.04
$1,990,758.56
$1,982,859.56
$1,975,564.15
$1,901,915.53
$1,822,992.80
$1,743,694.84
$1,611,718.78
$1,587,540.48
$1,393,144.51
$1,077,196.50
$1,045,798.51
$1,033,759.12
$938,971.92
$933,568.18
$854,372.81
$827,288.13
$727,152.63
Non-residential Building and Engineering Construction
Owner-Occupied Dwellings
Retail Trade
Legal, Accounting and Architectural, Engineering and Related Services
Wholesale Trade
Other Finance, Insurance and Real Estate and Management of Companies and Enterprises
Motor Vehicle Manufacturing
Lessors of Real Estate
Monetary Authorities and Depository Credit Intermediation
Accommodation and Food Services
Fabricated Metal Product Manufacturing
Railroad Rolling Stock Manufacturing
Computer Systems Design and Other Professional, Scientific and Technical Services
Other Transportation Equipment Manufacturing
Primary Metal Manufacturing
Petroleum and Coal Products Manufacturing
Pay TV, Specialty TV and Program Distribution and Telecommunications
Administrative and Support Services
Cement and Concrete Product Manufacturing
Insurance Carriers
Electric Power Generation, Transmission and Distribution
Rental and Leasing Services and Lessors of Non-Financial Intangible Assets (except Copyrighted Works)
Truck Transportation
Crop and Animal Production
Health Care Services (except Hospitals) and Social Assistance
Arts, Entertainment and Recreation
Repair Construction
Miscellaneous Food Manufacturing
Publishing Industries, Information Services and Data Processing Services
Meat Product Manufacturing

Figure 9 shows how this scenario (SC2) translates into occupation-specific employment impacts in the province over the period. Specifically, the expenditures associated with SC2 are projected to generate an additional 796,367 jobs in Ontario over the period. Those occupational groups projected to be most affected include:

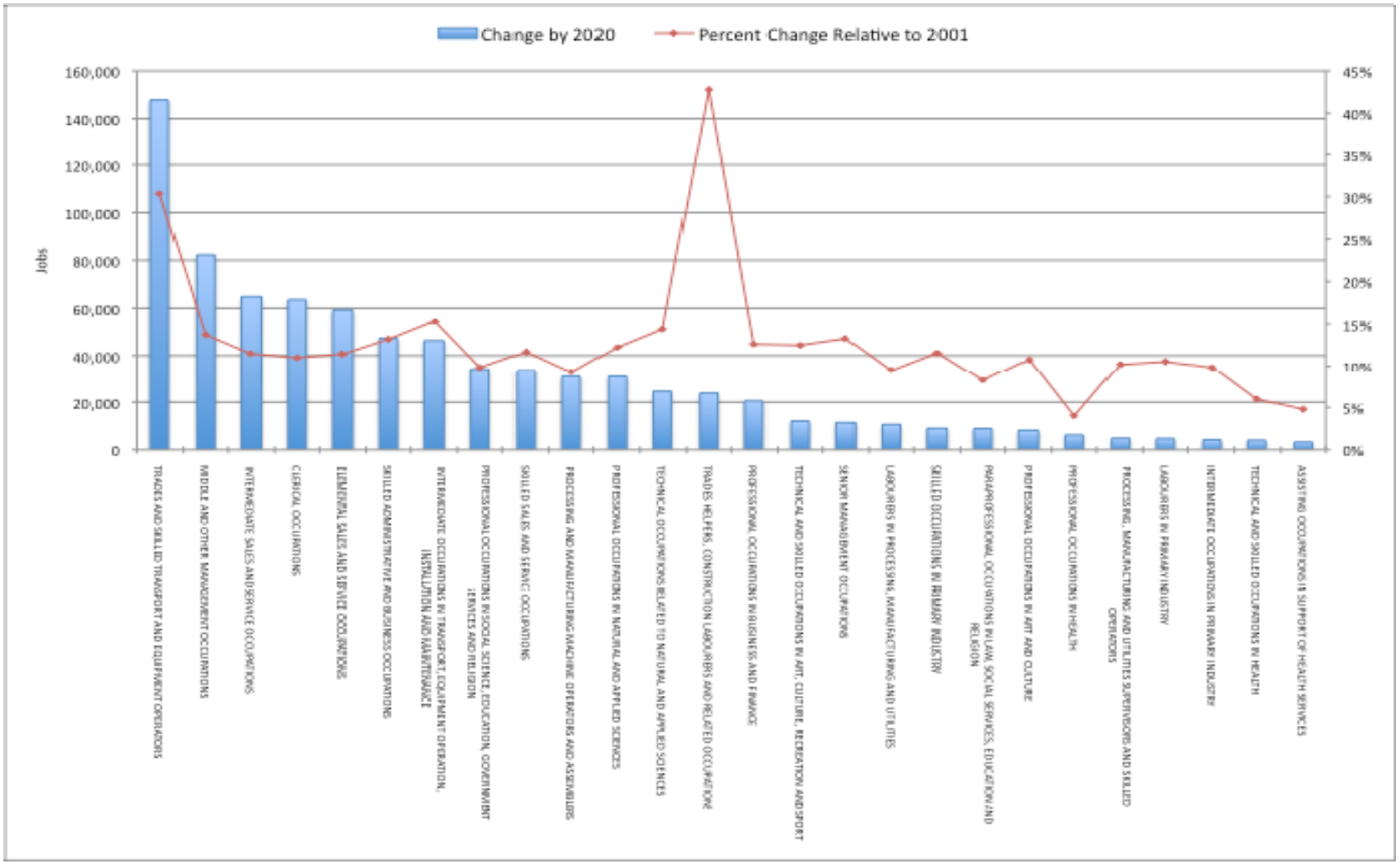
- Trades and Skilled Transport and Equipment Operators (30%);
- Middle and Other Management Occupations (14%);
- Intermediate Sales and Service Occupations (12%);
- Clerical Occupations (11%); and,
- Elemental Sales and Service Occupations (11%).

Once again skilled trades take a disproportionate amount of the employment impact with the occupational group "Trades and Skilled Transport and Equipment Operators" (approximately 19% of the total employment impact over the period). The occupational group "Trades Helpers, Construction Labourers and Related Occupations" is projected to experience the largest percentage increase in employment over the period at nearly 43 percent.

Interestingly, despite the heavy construction/engineering focus of SC2, more than one-third of the total employment impact provincially is projected to concentrate on mid-level management, sales and professional occupations. Indeed, SC2, which is composed entirely of public infrastructure projects which have been touted as being economic stimulators, stands to have a very substantial positive impact on the Province of Ontario over the period. Indeed, it would appear that price inflation due to factor constraints could be a very real issue if this scenario were to materialize. Especially, as is likely, if it occurs in tandem with one or several other large projects.

SC2 clearly stands to increase the demand for all goods and services produced in Ontario over the period. If SC2 materializes and the labour shortfalls envisioned in SC1 are realized, serious wage and other types of inflation are sure to result.

Figure 9: Occupation-specific Employment Impact of SC2



4.4 Scenario 3 (SC3): Implementation of the Ontario Power Authority's (OPA) Integrated Power System Plan (IPSP) ($60 billion).

The third scenario to be evaluated in this report focuses on the OPA's $60 billion Integrated Power Systems Plan (IPSP) for Ontario. The IPSP has two basic variants, a nuclear variant (Case 1A) and a non-nuclear variant (at least in the period to 2020) (Case 1B). Each of these plans represents a long-range integrated power system plan capable of making necessary repairs to the existing systems, as well as installing new capacity, to make Ontario energy self-sufficient over the long-term. This scenario does not consider all of the contracts that the OPA has (and will) sign with private partners who will invest in systems including wind mill farms and natural gas fired generating plants in exchange for long-term supply contracts with the Province of Ontario. In Case 1A, the IPSP will include the refurbishing and expansion of the Pickering B nuclear plant. Case 1B calls for the replacement of this nuclear capacity with natural gas fired systems. In each case, the expenditures over the period being considered here amount to approximately $60 billion.

Figure 5 above shows that SC3 is projected to have the largest positive impact on the provincial economy relative to all scenarios considered with a total provincial gross output impact in Ontario of impact of $191 billion over the period. Figure 10 shows that the total impact of the scenario is overwhelmingly concentrated, not surprisingly, in the "Non-residential Building and Engineering Construction" industry. Interestingly, wholesale and retail trade industries follow, which speaks to large indirect and induced impacts respectively. Figure 11 presents the total employment impact associated with SC3 in terms of specific occupational groups.

Figure 10:

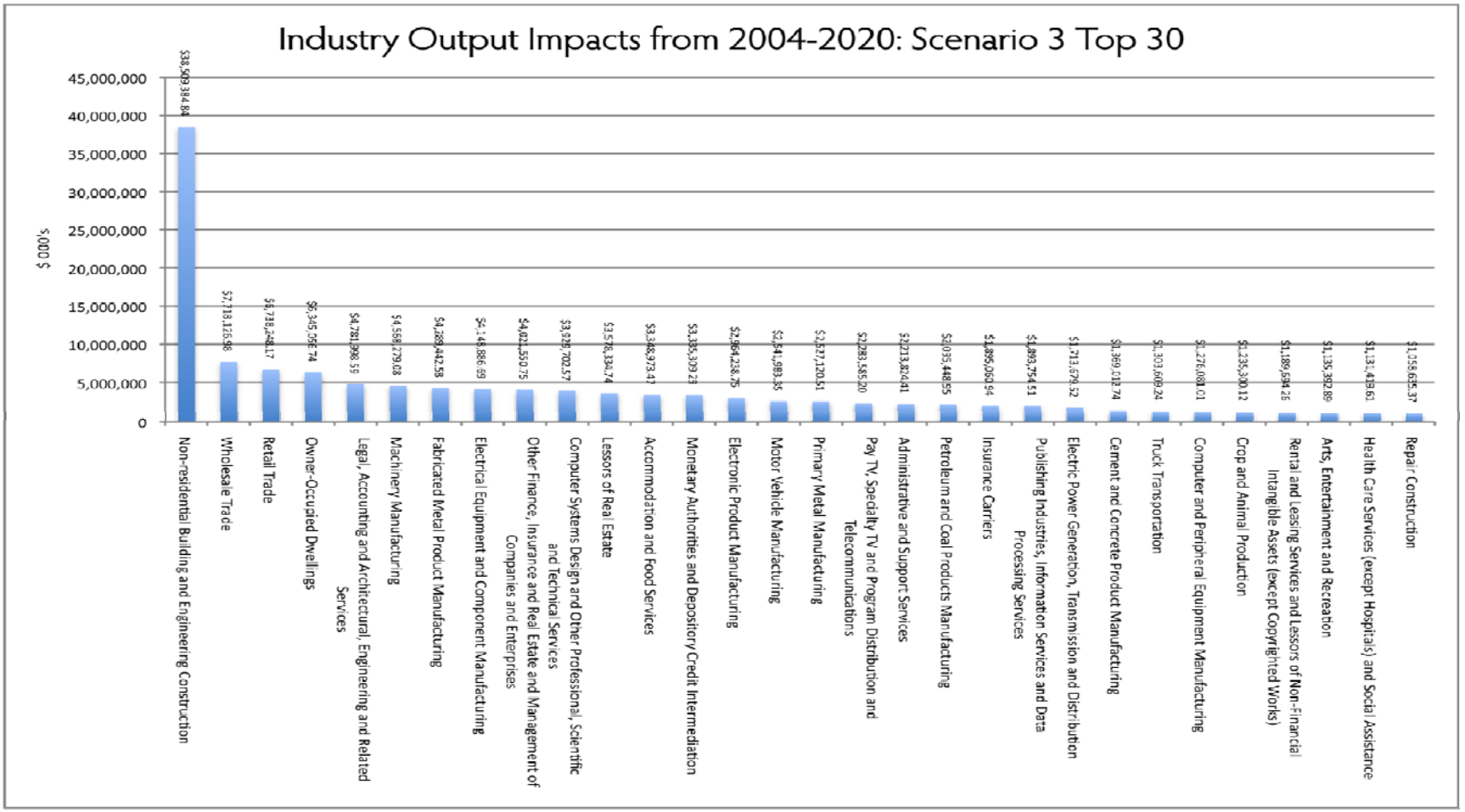
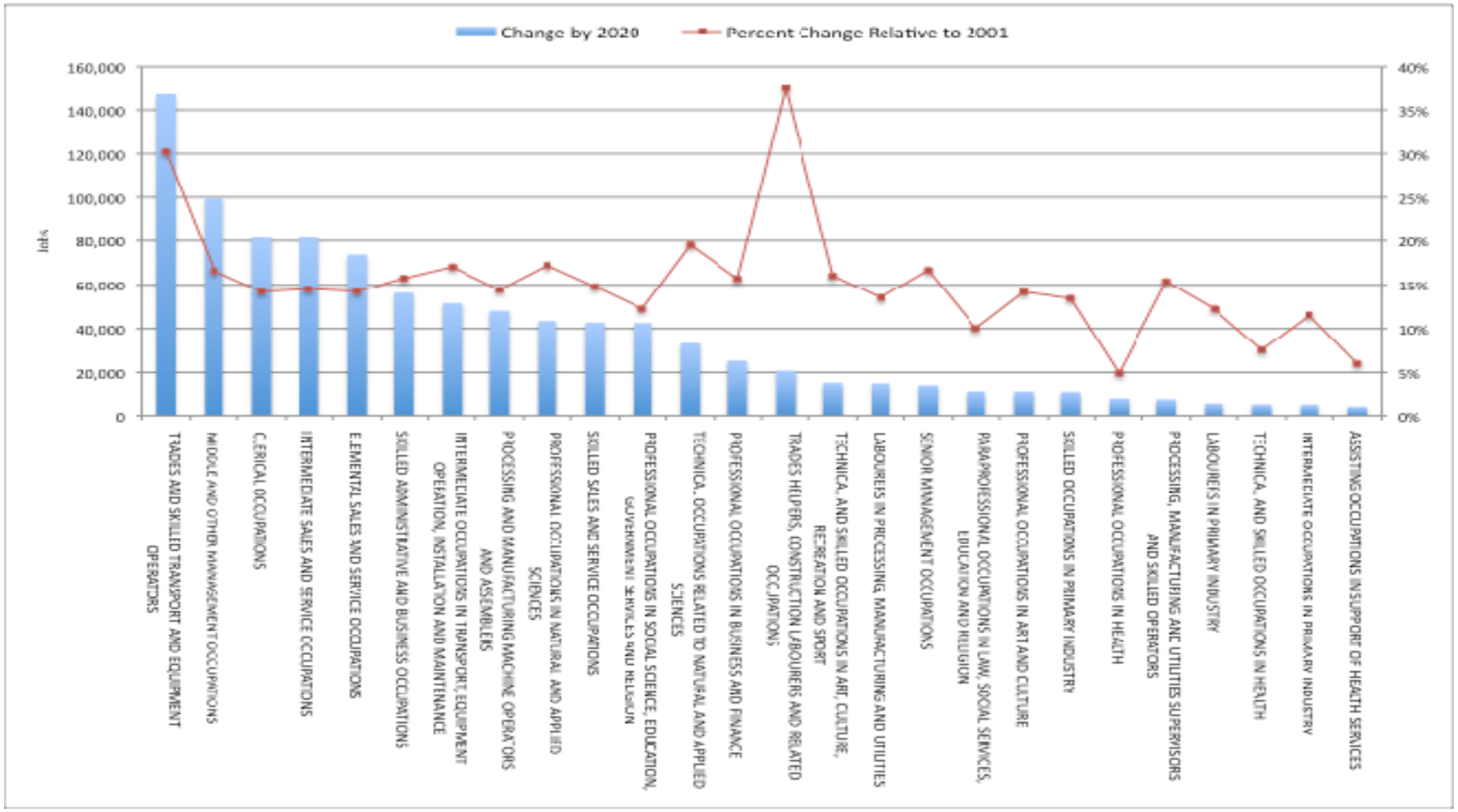

Industry Output Impacts from 2004-2020: Scenario 3 Top 30
$,000 $
45,000,000
40,000,000
35,000,000
30,000,000
25,000,000
20,000,000
15,000,000
10,000,000
5,000,000
0
$38,509,384.84
$7,718,126.98
$6,738,248.17
$6,345,356.74
$4,781,998.55
$4,568,279.08
$4,269,442.58
$4,148,886.69
$4,022,550.75
$3,935,702.57
$3,578,334.74
$3,486,973.47
$3,355,339.23
$2,964,238.75
$2,541,983.35
$2,327,120.51
$2,283,585.20
$2,213,824.41
$2,035,448.55
$1,895,050.94
$1,713,679.52
$1,369,618.74
$1,303,668.24
$1,226,068.01
$1,235,300.12
$1,189,594.26
$1,135,392.89
$1,131,458.61
$1,058,635.37
Non-residential Building and Engineering Construction
Wholesale Trade
Retail Trade
Owner-Occupied Dwellings
Legal, Accounting and Architectural, Engineering and Related Services
Machinery Manufacturing
Fabricated Metal Product Manufacturing
Electrical Equipment and Component Manufacturing
Other Finance, Insurance and Real Estate and Management of Companies and Enterprises
Computer Systems Design and Other Professional, Scientific and Technical Services
Lessors of Real Estate
Accommodation and Food Services
Monetary Authorities and Depository Credit Intermediation
Electronic Product Manufacturing
Motor Vehicle Manufacturing
Primary Metal Manufacturing
Pay TV, Specialty TV and Program Distribution and Telecommunications
Administrative and Support Services
Petroleum and Coal Products Manufacturing
Insurance Carriers
Publishing Industries, Information Services and Data Processing Services
Electric Power Generation, Transmission and Distribution
Cement and Concrete Product Manufacturing
Truck Transportation
Computer and Peripheral Equipment Manufacturing
Crop and Animal Production
Rental and Leasing Services and Lessors of Non-Financial Intangible Assets (except Copyrighted Works)
Arts, Entertainment and Recreation
Health Care Services (except Hospitals) and Social Assistance
Repair Construction

Figure 11: Occupation-specific Employment Impact of SC3



Those occupational groups most likely to experienced increased demand over the period include:

- Trades and Skilled Transport and Equipment Operators (the greatest absolute (147,218 positions) and percentage change (172%) over the period);
- Middle and Other Management Occupations (99,600 positions and 16% growth);
- Clerical Occupations (82,200 positions and 51% growth);
- Intermediate Sales and Service Occupations (81,895 positions and 23% growth); and,
- Elemental Sales and Service Occupations (73,742 positions and 13% growth).

4.5 Scenario 4 (SC4): A Fifty Percent Decline in the Demand for Motor Vehicles Manufactured in Ontario

The fourth and final scenario was inspired by the recent economic slow-down which has been having a disproportionately heavy impact on the Province of Ontario, and particularly its manufacturing core. Ontario is Canada's manufacturing heart, so it makes sense that its economy would be fundamentally organized around (and dependent on) manufacturing activities of all sorts. The Greater Golden Horseshoe (GGH), the urban region which accounts for the bulk of Ontario's manufacturing might, while highly diversified, is strongly oriented around (directly and indirectly) the manufacture of automobiles. If, as doomsayers suggest, access to credit for the purchase of automobiles is to be forever changed and consumer preferences continue to shift away from North American automobiles, then one has to wonder how this could impact the GGH and ultimately the Province. To implement this scenario, the sum total of projected future intermediate and final demand for motor vehicles produced in Ontario was cut by 50 percent. This figure was chosen arbitrarily to examine how sensitive the economy (as represented in this model by 105 interacting industries) would react to the significant reduction of one element (essentially a

row total) in the model. The economy-wide and temporal impact of this scenario can be seen in Figure 5 above (see SC4).

Figure 5 shows that a 50 percent reduction in the demand for the output of the provincial "Motor Vehicle Manufacturing" industry could cause a drastic reduction in the level of economic activity in the province relative to the baseline. Indeed, this reduction of more than $23 billion in manufacturing activity results in an economic slow-down that is nearly as severe as that which was associated with SC1 – the skilled trades deficit scenario ($40 billion loss in manufacturing output). Interestingly, the reduction manufacturing output in SC1 was spread over all manufacturing industries in proportion to each industry's importance in the economy. In SC4, the entire loss, $23 billion, was allocated to one manufacturing sector, "Motor Vehicle Manufacturing". The fact that changing one number, albeit a big one, brings on such a significant change in the long-term performance of the provincial economy underscores our vulnerability to the vagaries of national and international business cycles.

Figure 12 shows that a $23 billion reduction in motor vehicle manufacturing over the period has the potential to spark a total economic impact in Ontario of nearly $54 billion over the period. The bulk of the total impact, not surprisingly, would be felt in the motor vehicle manufacturing industry itself, accounting for nearly 50% of the total impact. Other industries which are likely to show significant impacts include:

- Motor Vehicle Parts Manufacturing;
- Wholesale Trade;
- Retail Trade; and,
- Legal, Accounting and Architectural, Engineering and Related Services.

Figure 12:

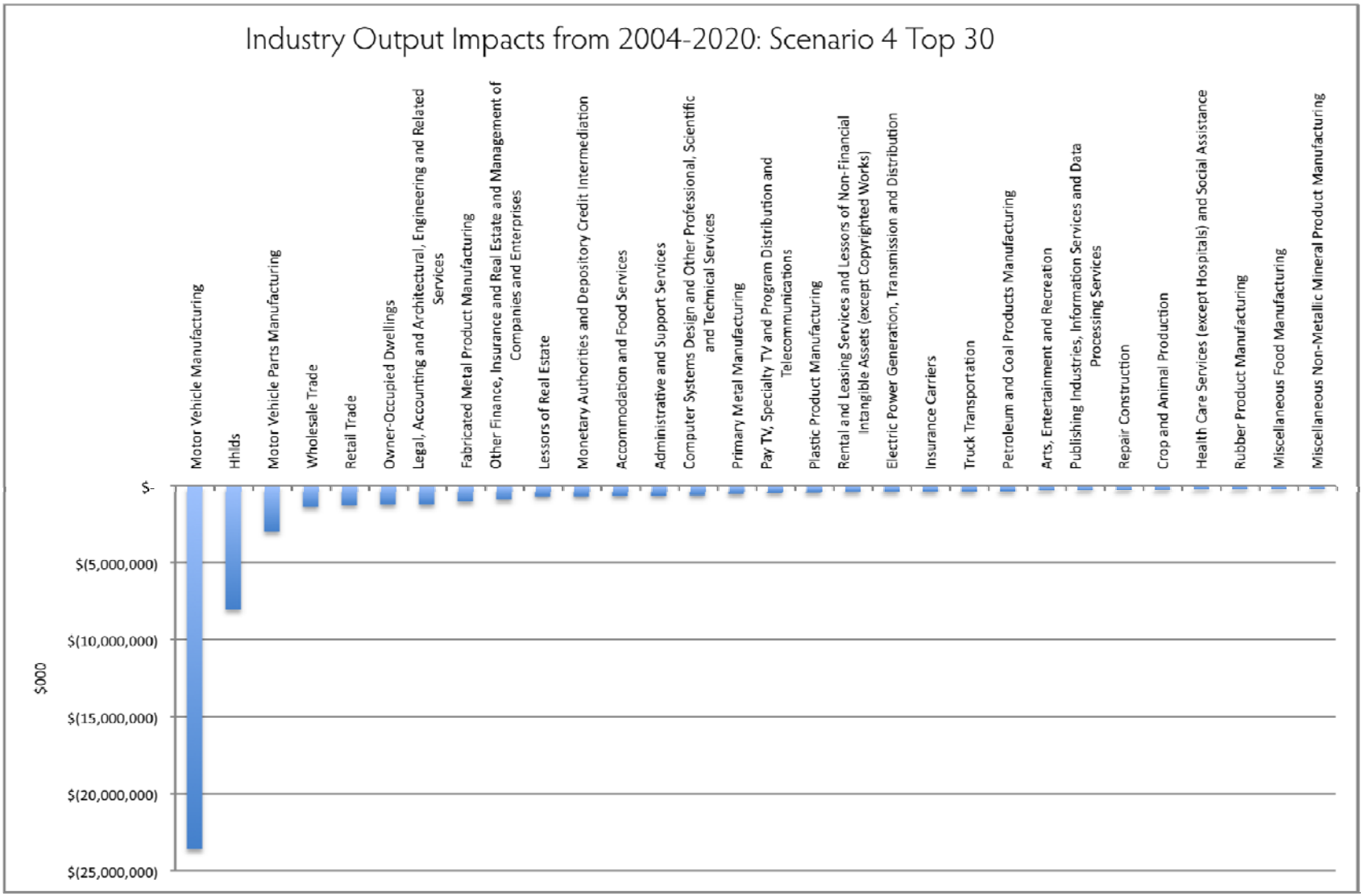
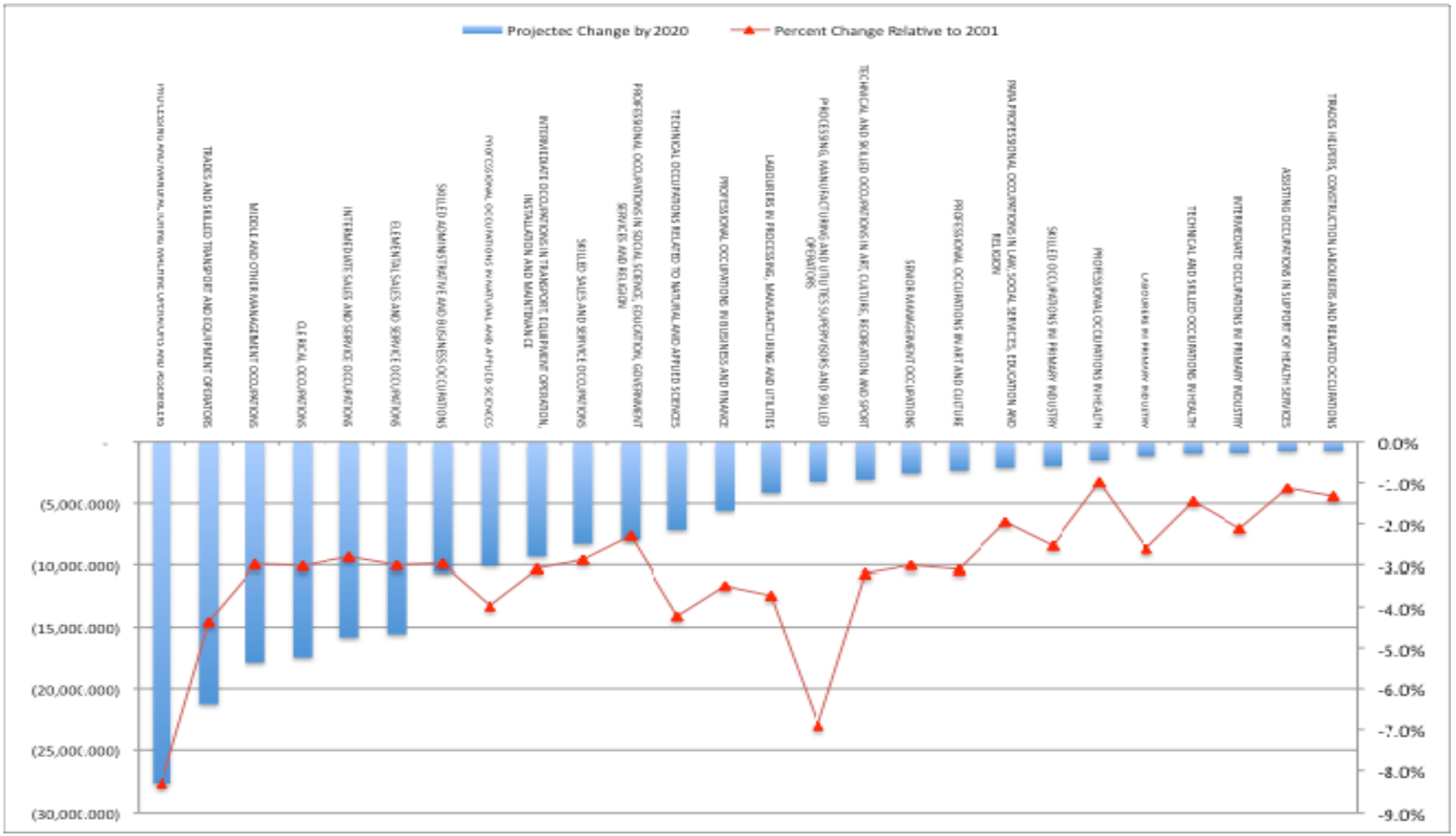

Industry Output Impacts from 2004-2020: Scenario 4 Top 30
$000
$-
$(5,000,000)
$(10,000,000)
$(15,000,000)
$(20,000,000)
$(25,000,000)
Motor Vehicle Manufacturing
Hhlds
Motor Vehicle Parts Manufacturing
Wholesale Trade
Retail Trade
Owner-Occupied Dwellings
Legal, Accounting and Architectural, Engineering and Related Services
Fabricated Metal Product Manufacturing
Other Finance, Insurance and Real Estate and Management of Companies and Enterprises
Lessors of Real Estate
Monetary Authorities and Depository Credit Intermediation
Accommodation and Food Services
Administrative and Support Services
Computer Systems Design and Other Professional, Scientific and Technical Services
Primary Metal Manufacturing
Pay TV, Specialty TV and Program Distribution and Telecommunications
Plastic Product Manufacturing
Rental and Leasing Services and Lessors of Non-Financial Intangible Assets (except Copyrighted Works)
Electric Power Generation, Transmission and Distribution
Insurance Carriers
Truck Transportation
Petroleum and Coal Products Manufacturing
Arts, Entertainment and Recreation
Publishing Industries, Information Services and Data Processing Services
Repair Construction
Crop and Animal Production
Health Care Services (except Hospitals) and Social Assistance
Rubber Product Manufacturing
Miscellaneous Food Manufacturing
Miscellaneous Non-Metallic Mineral Product Manufacturing

Figure 13 shows that the employment impacts associated with the automotive downturn would likely be concentrated in the skilled trades - "Processing and Manufacturing Machine Operators and Assemblers" and "Trades and Skilled Transport and Equipment Operators". Also hit hard in this scenario would be "Middle and Other Management Occupations" and "Clerical Occupations". Indeed, Figure 13 shows that few occupations would be spared if automotive manufacturing activity were to be significantly cut in Ontario.

Figure 13: Occupation-specific Employment Impact of SC4



4.6 A Closer Look at the Occupation-Specific Employment Impacts

Figures 14 through 18 present detailed pictures of the temporal trajectories for each of the occupational groups over the period from 2001 to 2020.[32] Across all scenarios, the employment impacts are dominated by the following occupational groups:

- Intermediate Sales and Service Occupations;
- Middle and Other Management Occupations;
- Clerical Occupations;
- Elemental Sales and Service Occupations; and,
- Trades and Skilled Transport and Equipment Operators.

Across all five scenarios, these occupations rank 5 to 8 in terms of the magnitude of the employment impact (positive or negative) projected. This is a reflection of the importance of these occupational groups in the base data used to calibrate the model.

Figures 14 through 18 also show that while the demand for the traditional skilled trades occupations will likely increase substantially, the five scenarios evaluated herein stand to place very broad pressures on the provincial labour market. Occupational groups as disparate as "Clerical Occupations", "Labourers in Processing, Manufacturing and Utilities", and "Professional Occupations in Social Science, Education, Government Services and Religion" all stand to experience substantial growth in demand over the period out to 2020. This fact, in light of earlier comments regarding the aging workforce in Ontario suggests that labour shortages, especially in the highly skilled/educated occupations, would not be an unreasonable expectation.

[32] Temporal detail was truncated in these figures for ease of presentation.

Figure 14: Temporal Trajectory of Employment Impacts by Occupation: Baseline Scenario

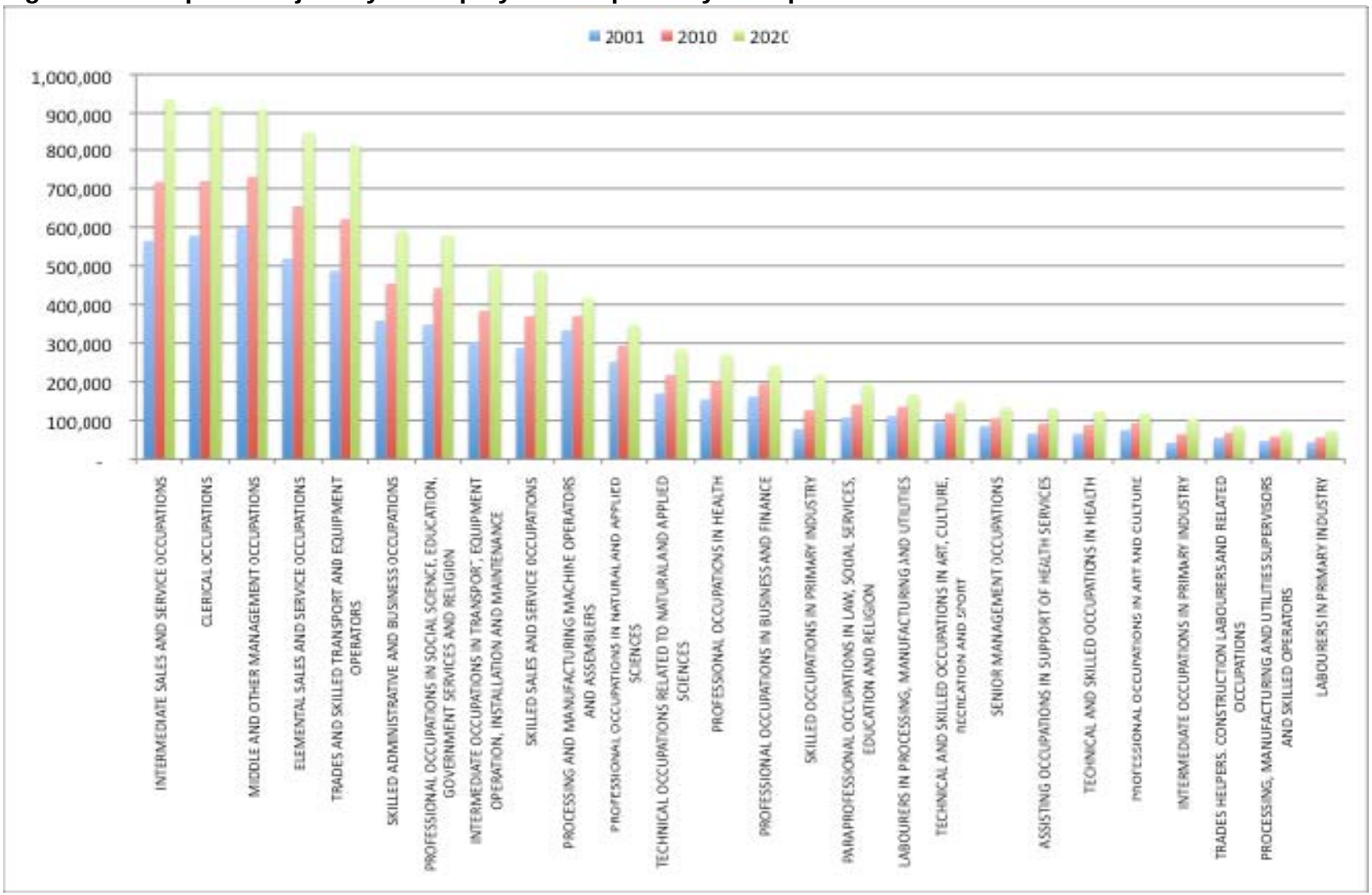


Figure 15: Temporal Trajectory of Employment Impacts by Occupation: SC1

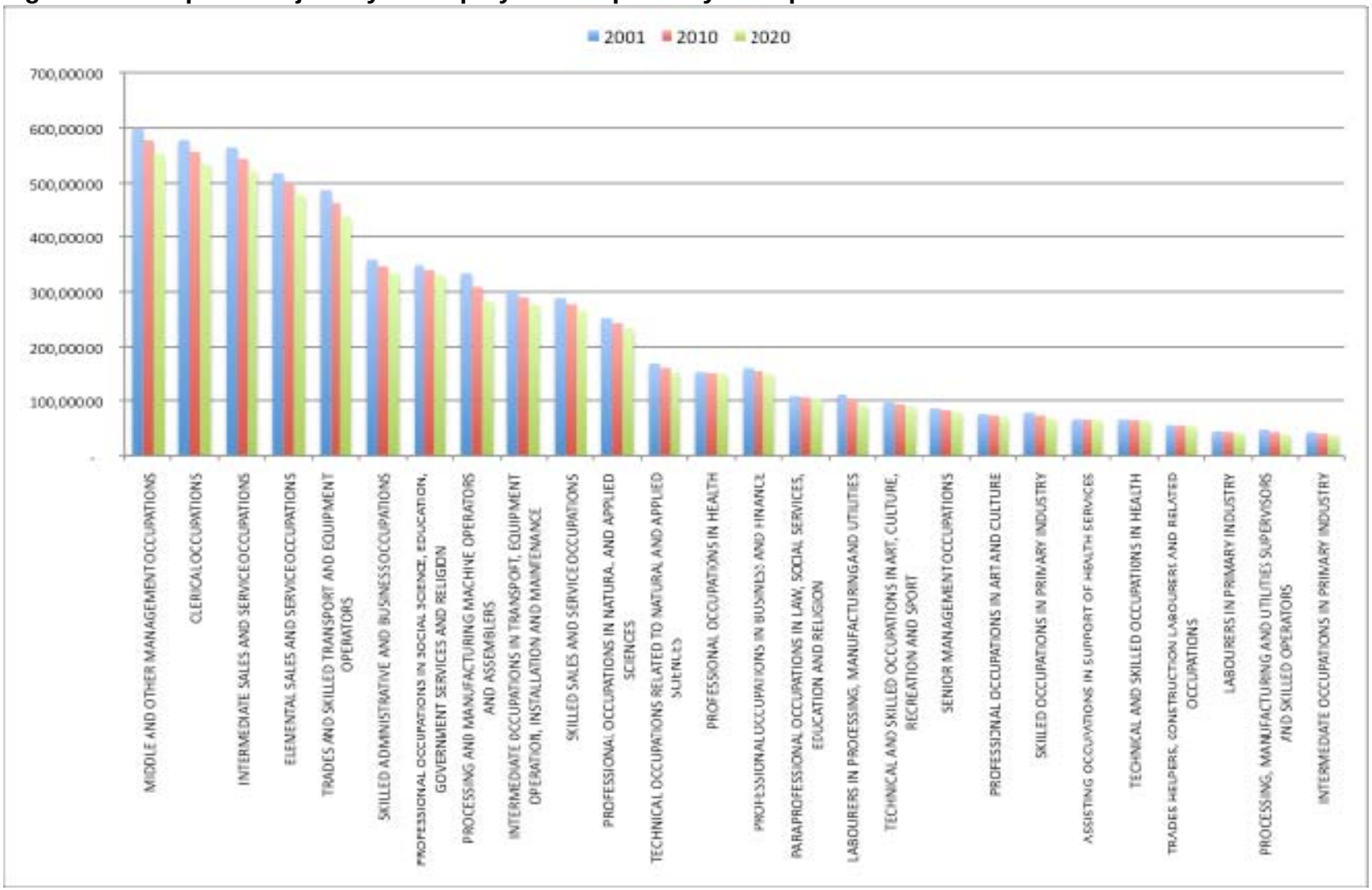


Figure 16: Temporal Trajectory of Employment Impacts by Occupation: SC2

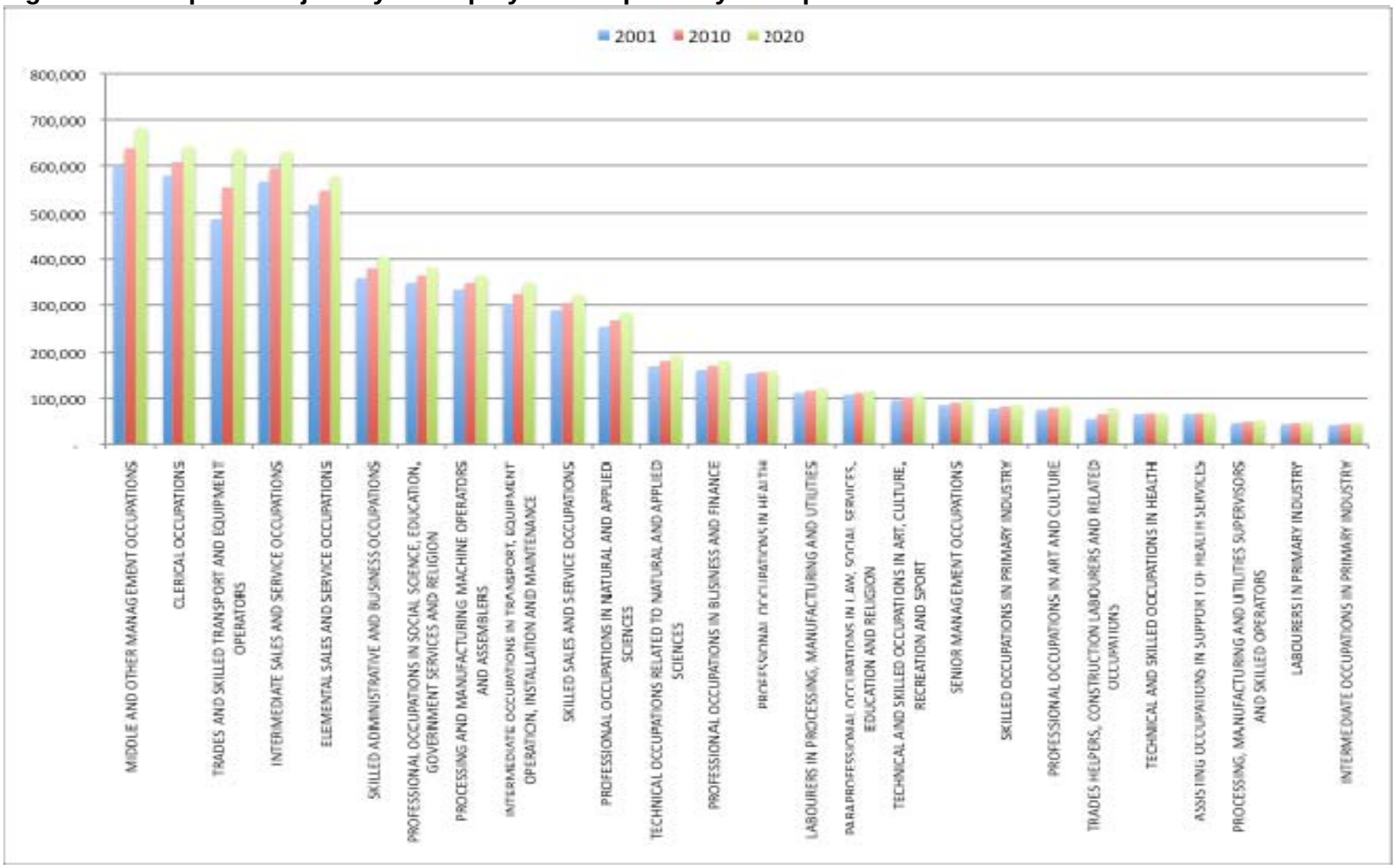


Figure 17: Temporal Trajectory of Employment Impacts by Occupation: SC3

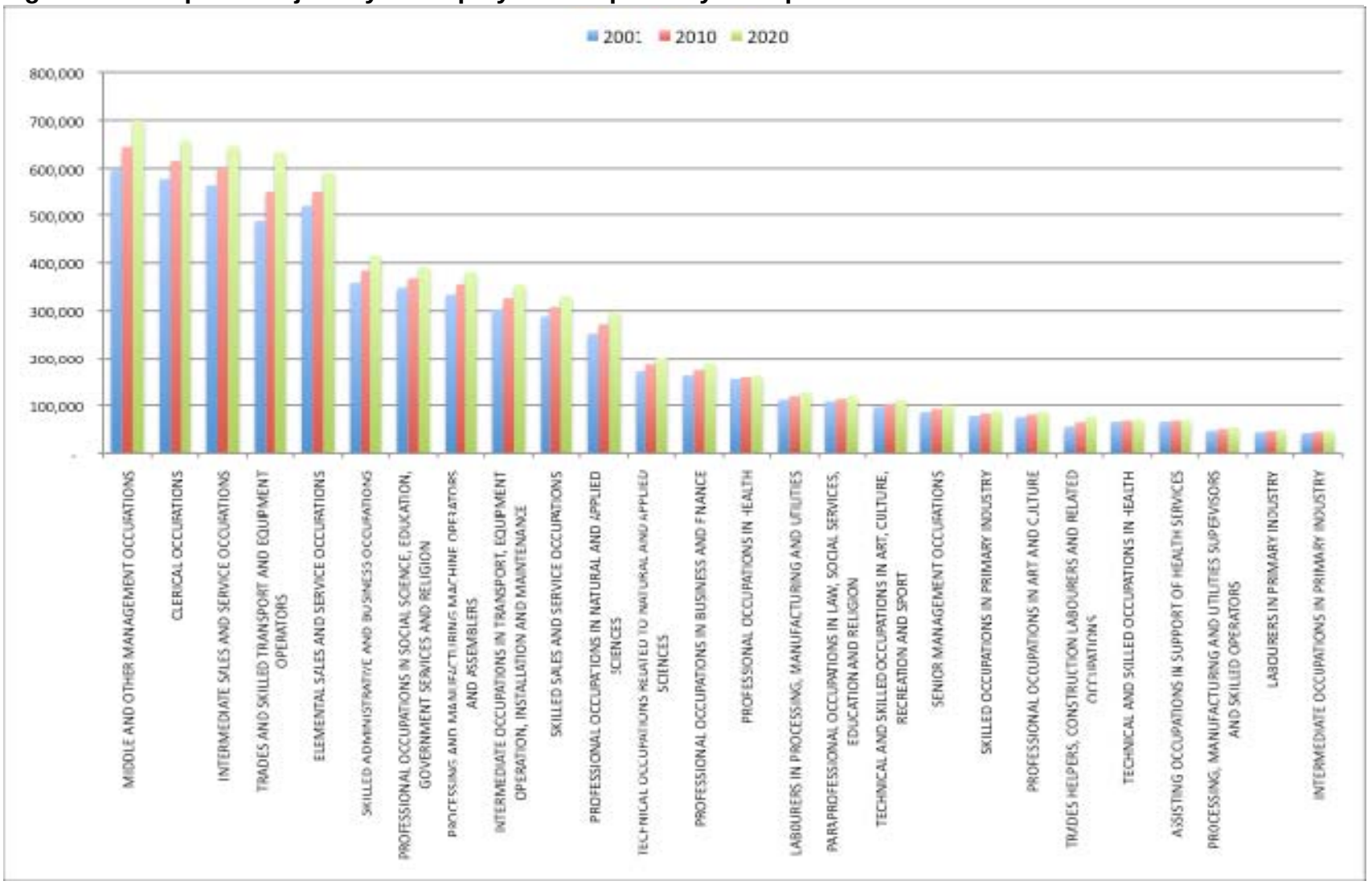
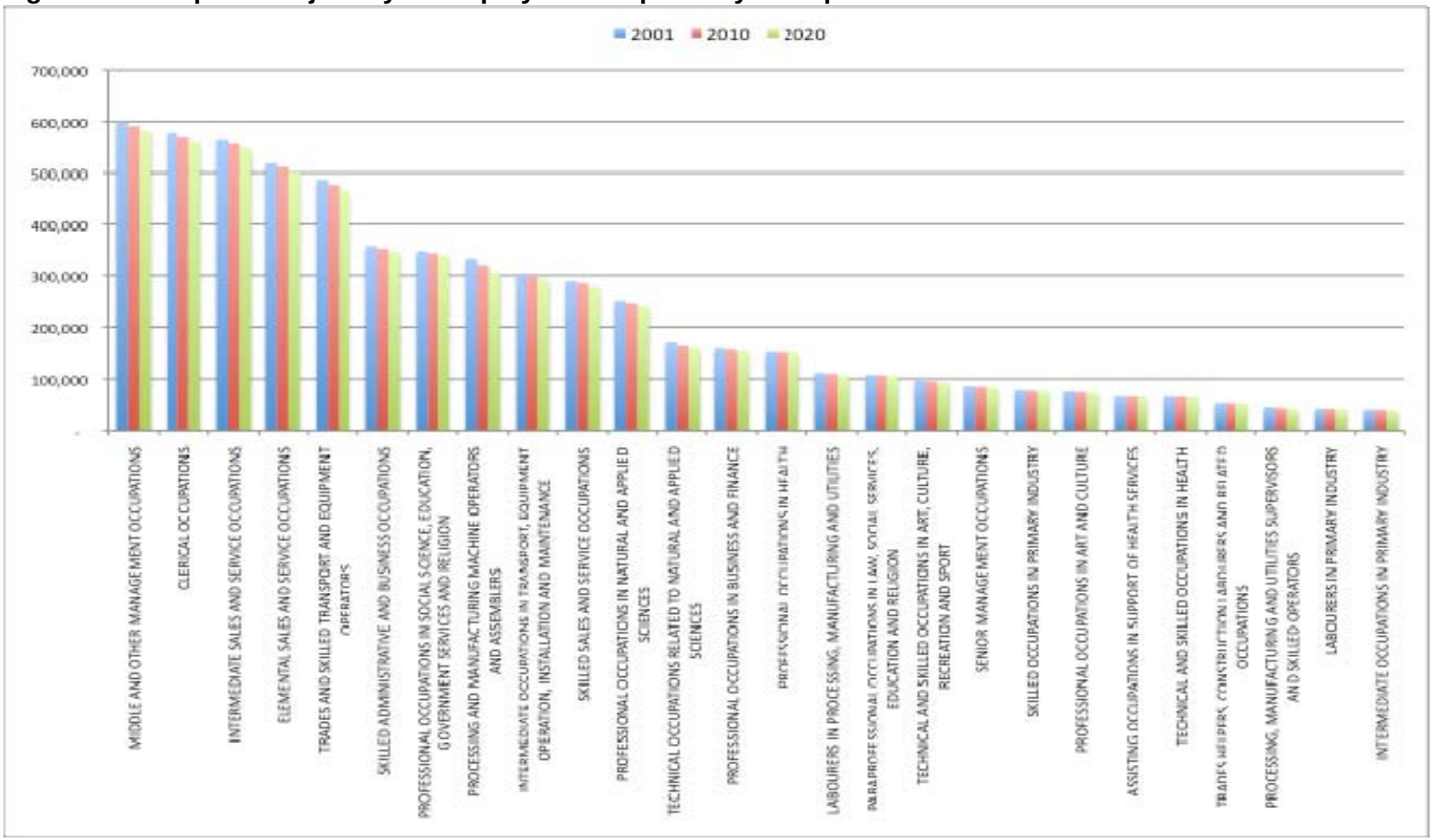


Figure 18: Temporal Trajectory of Employment Impacts by Occupation: SC4



5.0 Discussion and Conclusions

The objective in conducting this analysis was to develop a set of plausible pictures of what Ontario could look like in 2020 given the myriad forces that affect the size and structure of the Province's economy. Our approach involved using the professional/scholarly literatures to establish a baseline trajectory to 2020 and then using the same literatures to devise a set of reasonable scenarios for Ontario over the period to 2020. The results reported above do provide a series of plausible scenarios for Ontario, and each is accompanied by a detailed presentation of how this scenario could lead to change in Ontario relative to the baseline. The scenarios discussed are all from the present day's headlines and policy debates and represent probable trajectories for Ontario. Indeed, several of the infrastructure projects discussed above have already begun (e.g., ReNew Ontario and MoveOntario 2020). A look at Figure 5 above can lead to at least two impressions. The optimistic impression is that it takes some very significant economic losses to pull the province away from the baseline trajectory. However, as the automotive scenario (SC4) shows, a massive hit in one very sensitive spot can have disastrous implications for the Province of Ontario. While it is true that Ontario is a diversified economy, it is still fundamentally tied to the manufacturing core located in the GGH. The economic booms and busts in Ontario are tied to the fortunes of the manufacturers located in the GGH region of Ontario.

While this analysis is very instructive in terms of the possible range of scenarios that could be envisioned over the next 12 years to 2020 and their likely impacts, there is much that was not considered. First and foremost, Ontario is conceptualized as being a recipient (or a taker) of whatever the global market sends its way. Ontario is a powerhouse of economic activity and innovation, and it is certainly not powerless to protect itself from the types of negative economic outcomes seen in Scenarios 1 and 4 here. Also, while it is mentioned parenthetically in the text above, the fact is that the IO framework does not allow for endogenous structural change. A labour shortage could indeed lead to

calamity or it could cause provincial firms to decrease their reliance on this input over time, either by off-shoring the jobs or by replacing the labour with capital or with less-skilled labour. These input substitutions represent structural changes, and while the researcher can "impress" them on the model ex post, the modelling framework does not adjust these mixes "on-the-fly" as would a Computable General Equilibrium (CGE) model. With that said, CGE models are not empirically tractable at the provincial scale in Canada (indeed they require herculean efforts to implement them nationally). Practicality and ease of use aside, a CGE model would allow for a more realistic modelling of the provincial economy out to 2020 insofar as input structures are concerned, though such a model would likely not have the industry or occupational detail of the model developed for this exercise.

In closing, this analysis underscores the reality that labour market planning and intelligence (LMI) is imperative and that long-range planning at the provincial scale cannot take place without explicitly acknowledging the bi-directional relationship between the structure and size of the economy, and the size and composition of its labour force. Proactive efforts can foretell broad shifts in employer requirements and implement these in the provincial educational and training systems in an effort to mitigate some of the negative effects of shortfalls, and to capitalize on specific advantages. Future research regarding the future of Ontario out to 2020 and beyond should focus specifically on how best to gather this LMI, and how to use it to develop the skilled, creative and yet flexible work force that it requires to enjoy decades of continued prosperity.

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Appendix A: NOC Major Groups

	Major Groups
1	SENIOR MANAGEMENT OCCUPATIONS
2	MIDDLE AND OTHER MANAGEMENT OCCUPATIONS
3	PROFESSIONAL OCCUPATIONS IN BUSINESS AND FINANCE
4	SKILLED ADMINISTRATIVE AND BUSINESS OCCUPATIONS
5	CLERICAL OCCUPATIONS
6	PROFESSIONAL OCCUPATIONS IN NATURAL AND APPLIED SCIENCES
7	TECHNICAL OCCUPATIONS RELATED TO NATURAL AND APPLIED SCIENCES
8	PROFESSIONAL OCCUPATIONS IN HEALTH
9	TECHNICAL AND SKILLED OCCUPATIONS IN HEALTH
10	ASSISTING OCCUPATIONS IN SUPPORT OF HEALTH SERVICES
11	PROFESSIONAL OCCUPATIONS IN SOCIAL SCIENCE, EDUCATION, GOVERNMENT SERVICES AND RELIGION
12	PARAPROFESSIONAL OCCUPATIONS IN LAW, SOCIAL SERVICES, EDUCATION AND RELIGION
13	PROFESSIONAL OCCUPATIONS IN ART AND CULTURE
14	TECHNICAL AND SKILLED OCCUPATIONS IN ART, CULTURE, RECREATION AND SPORT
15	SKILLED SALES AND SERVICE OCCUPATIONS
16	INTERMEDIATE SALES AND SERVICE OCCUPATIONS
17	ELEMENTAL SALES AND SERVICE OCCUPATIONS
18	TRADES AND SKILLED TRANSPORT AND EQUIPMENT OPERATORS
19	INTERMEDIATE OCCUPATIONS IN TRANSPORT, EQUIPMENT OPERATION, INSTALLATION AND MAINTENANCE
20	TRADES HELPERS, CONSTRUCTION LABOURERS AND RELATED OCCUPATIONS
21	SKILLED OCCUPATIONS IN PRIMARY INDUSTRY
22	INTERMEDIATE OCCUPATIONS IN PRIMARY INDUSTRY
23	LABOURERS IN PRIMARY INDUSTRY
24	PROCESSING, MANUFACTURING AND UTILITIES SUPERVISORS AND SKILLED OPERATORS
25	PROCESSING AND MANUFACTURING MACHINE OPERATORS AND ASSEMBLERS
26	LABOURERS IN PROCESSING, MANUFACTURING AND UTILITIES

Appendix B: NAICS Link-Level Industries

No.	Code	Description
1	11A0	Crop and Animal Production
2	1130	Forestry and Logging
3	1140	Fishing, Hunting and Trapping
4	1150	Support Activities for Agriculture and Forestry
5	2111	Oil and Gas Extraction
6	2121	Coal Mining
7	2122	Metal Ore Mining
8	2123	Non-Metallic Mineral Mining and Quarrying
9	2131	Support Activities for Mining and Oil and Gas Extraction
10	2211	Electric Power Generation, Transmission and Distribution
11	221A	Natural Gas Distribution, Water, Sewage and Other Systems
12	230A	Residential Building Construction
13	230X	Non-residential Building and Engineering Construction
14	230H	Repair Construction
15	230I	Other Activities of the Construction Industry
16	3111	Animal Food Manufacturing
17	3113	Sugar and Confectionery Product Manufacturing
18	3114	Fruit and Vegetable Preserving and Specialty Food Manufacturing
19	3115	Dairy Product Manufacturing
20	3116	Meat Product Manufacturing
21	3117	Seafood Product Preparation and Packaging
22	311A	Miscellaneous Food Manufacturing
23	312A	Soft Drink and Ice Manufacturing
24	312B	Breweries
25	312C	Wineries
26	312D	Distilleries
27	3122	Tobacco Manufacturing
28	31A0	Textile and Textile Product Mills
29	3150	Clothing Manufacturing
30	3160	Leather and Allied Product Manufacturing
31	3210	Wood Product Manufacturing
32	3221	Pulp, Paper and Paperboard Mills
33	3222	Converted Paper Product Manufacturing
34	3231	Printing and Related Support Activities
35	3241	Petroleum and Coal Products Manufacturing
36	3251	Basic Chemical Manufacturing
37	3252	Resin, Synthetic Rubber, and Artificial and Synthetic Fibers and Filaments Manufacturing
38	3253	Pesticides, Fertilizer and Other Agricultural Chemical Manufacturing
39	3254	Pharmaceutical and Medicine Manufacturing
40	325A	Miscellaneous Chemical Product Manufacturing
41	3261	Plastic Product Manufacturing
42	3262	Rubber Product Manufacturing
43	3273	Cement and Concrete Product Manufacturing
44	327A	Miscellaneous Non-Metallic Mineral Product Manufacturing
45	3310	Primary Metal Manufacturing

46	3320	Fabricated Metal Product Manufacturing
47	3330	Machinery Manufacturing
48	3341	Computer and Peripheral Equipment Manufacturing
49	334A	Electronic Product Manufacturing
50	3352	Household Appliance Manufacturing
51	335A	Electrical Equipment and Component Manufacturing
52	3361	Motor Vehicle Manufacturing
53	3362	Motor Vehicle Body and Trailer Manufacturing
54	3363	Motor Vehicle Parts Manufacturing
55	3364	Aerospace Product and Parts Manufacturing
56	3365	Railroad Rolling Stock Manufacturing
57	3366	Ship and Boat Building
58	3369	Other Transportation Equipment Manufacturing
59	3370	Furniture and Related Product Manufacturing
60	3390	Miscellaneous Manufacturing
61	4100	Wholesale Trade
62	4A00	Retail Trade
63	4810	Air Transportation
64	4820	Rail Transportation
65	4830	Water Transportation
66	4840	Truck Transportation
67	4850	Transit and Ground Passenger Transportation
68	4860	Pipeline Transportation
69	48B0	Scenic and Sightseeing Transportation and Support Activities for Transportation
70	49A0	Postal Service and Couriers and Messengers
71	4930	Warehousing and Storage
72	5120	Motion Picture and Sound Recording Industries
73	5131	Radio and Television Broadcasting
74	513A	Pay TV, Specialty TV and Program Distribution and Telecommunications
75	51A0	Publishing Industries, Information Services and Data Processing Services
76	5A01	Monetary Authorities and Depository Credit Intermediation
77	5A02	Insurance Carriers
78	5A03	Lessors of Real Estate
79	5A04	Owner-Occupied Dwellings
80	5A05	Rental and Leasing Services and Lessors of Non-Financial Intangible Assets (except Copyrighted Works)
81	5A06	Other Finance, Insurance and Real Estate and Management of Companies and Enterprises
82	5418	Advertising and Related Services
83	541A	Legal, Accounting and Architectural, Engineering and Related Services
84	541B	Computer Systems Design and Other Professional, Scientific and Technical Services
85	5610	Administrative and Support Services
86	5620	Waste Management and Remediation Services
87	611A	Educational Services (except Universities)
88	62A0	Health Care Services (except Hospitals) and Social Assistance
89	7100	Arts, Entertainment and Recreation
90	7200	Accommodation and Food Services
91	8110	Repair and Maintenance
92	813A	Grant-Making, Civic, and Professional and Similar Organizations
93	81A0	Personal and Laundry Services and Private Households
94	NP11	Religious Organizations

95	NP12	Non-Profit Welfare Organizations
96	NP13	Non-Profit Sports and Recreation Clubs
97	NP19	Other Non-Profit Institutions Serving Households
98	NP20	Non-Profit Education Institutions
99	GS11	Hospitals
100	GS12	Government Residential Care Facilities
101	GS21	Universities
102	GS22	Government Education Services
103	GS40	Other Municipal Government Services
104	GS50	Other Provincial and Territorial Government Services
105	GS60	Other Federal Government Services

Author Bio

Dr. Richard J. DiFrancesco has been consulting, researching, and teaching in the fields of regional economic development planning, impact analysis, modeling and forecasting for more than a decade. Rick is a Professor in the Department of Geography & Programme in Planning at the University of Toronto; a Full-Member of the Canadian Institute of Planners and the Ontario Professional Planning Institute; has published in internationally peer-reviewed journals dealing with regional economic development, mathematical modeling, planning, and analysis; has been the recipient of several federally funded research grants to study and model regional economic systems; has presented dozens of papers at meetings of professional and scholarly societies; and, has been teaching Canada's newest generation of economists, geographers, planners, and civil engineers about regional economic analysis, modeling, and planning since 1995.

Working Paper Series

This working paper is part of the *Ontario in the Creative Age* series, a project we are conducting for the Ontario Government. The project was first announced in the 2008 Ontario Budget Speech, and its purpose is to understand the changing composition of Ontario's economy and workforce, examine historical changes and projected future trends affecting Ontario, and provide recommendations to the Province for ensuring that Ontario's economy and people remain globally competitive and prosperous.

The purpose of the working papers in this series is to engage selected issues related to our report: *Ontario in the Creative Age*. The series will involve a number of releases over the course of the coming months. Each paper has been reviewed for content and edited for clarity by Martin Prosperity Institute staff and affiliates. As working papers, they have not undergone rigorous academic peer review.

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