



# Sectoral Profile

## Chemical Manufacturing

Ontario

2017-2019



Sectoral Profiles provide an overview of recent labour market developments and outlooks for some of the key industries in various regions of the country

### MODERATE GROWTH AMID SOME UNCERTAINTY

- Employment in the chemical manufacturing sector has declined over the last decade but modest growth is expected in the 2017-2019 period.
- Manufacturing sales and exports in this sector have been growing steadily in the post-recession period with a slight decline in recent years.
- The sector should see some growth as the pharmaceutical and medicine manufacturing subsector, the largest contributor to employment and sales for this sector, continues to gain new investments and expands to newer markets and products.
- The increasing investments in biochemicals and marijuana products could provide the sector with a boost over the forecast period.
- As an export intensive sector, the chemical manufacturing industry will be particularly vulnerable to uncertainty in oil prices, volatility in exchange rates, and unpredictability of trade relationships.
- The future health of the sector will depend on its potential to remain competitive while navigating environmental regulations and high energy prices.

Ontario has the largest chemical manufacturing sector in Canada accounting for about 44% of the nation's total employment<sup>1</sup> and about 40% of total production<sup>2</sup> for this sector. While the Windsor-Sarnia region has the most concentrated chemicals cluster in the country, over half of the provincial workforce for this sector is located in the Toronto Economic Region (ER).

This sector is composed of seven subsectors: 1) Basic chemical manufacturing, 2) Resin, synthetic rubber, and artificial and synthetic fibres and filaments manufacturing, 3) Pesticide, fertilizer and other agricultural chemical manufacturing, 4) Pharmaceutical and medicine manufacturing, 5) Paint, coating and adhesive manufacturing, 6) Soap, cleaning compound and toilet preparation manufacturing, and 7) Other chemical manufacturing. Pharmaceutical and medicine manufacturing forms the largest subsector, making up just over a third of employment<sup>3</sup> and accounting for about 50% of the GDP for the sector.<sup>4</sup>

As a value-added, energy intensive, and export intensive sector, chemical manufacturing is sensitive to fluctuations in energy prices, instability in exchange rates, and uncertainty in trade relations.

**Employment should remain stable over the forecast period**

Employment in the chemical manufacturing sector peaked in 2003 and has seen an overall decline over the past decade. However, employment in the sector has seen minor improvement over the last year. In 2017, employment increased by 800 (+1.8%) according to Labour Force Survey.

As a high productivity sector, a greater proportion of its jobs tend to be concentrated at the upper end of the global value chain.<sup>5</sup> As a result, the sector includes a diverse array of workers with higher skills, training, and education levels that are suited to the operation of complex and specialized equipment, processes, and technologies.<sup>6</sup>

Some of the key occupations in the chemical manufacturing sector include<sup>7</sup>:

- Chemical plant machine operators (NOC 9421)
- Petroleum, gas and chemical process operators (NOC 9232)
- Chemical technologists and technicians (NOC 2211)
- Other labourers in processing, manufacturing and utilities (NOC 9619)
- Chemists (NOC 2112)
- Manufacturing managers (NOC 0911)

The chemical manufacturing sector is changing with the expansion to new areas, development of new products, and technological advancements. The emergence of the marijuana industry is creating new jobs and laying the foundation for new occupations. Employers in the industry have indicated a growing need for workers with industry specific knowledge and several colleges and universities are providing training for careers in the industry.<sup>8,9</sup> While the growth in medical marijuana could provide some avenue for an increase in jobs, the potential adoption of next-generation digitization could have the opposite effect. Advances in machine learning, increased use of robotics, and artificial intelligence enabled systems could potentially allow chemical manufacturing companies to do more with fewer people.<sup>10</sup> While the sector in Ontario has not adopted such digitization to the same extent that some global players have, the current hypercompetitive, low-growth context of manufacturing may require the sector to move towards such digitization to reduce costs. This could potentially affect future employment in the sector.

This sector includes diverse subsectors that not only produce end-use products but also add value to raw resources creating intermediate products that are used as inputs within the sector and by several other sectors.<sup>11</sup> As a result, demand or supply fluctuations in other sectors can affect the health and growth of chemical manufacturing.

**Declining sales of patented medications a bitter pill to swallow**

The pharmaceutical and medicine manufacturing subsector is a significant contributor to the chemical manufacturing sector, accounting for over a third of its workers<sup>12</sup> and about a quarter of its sales.<sup>13</sup> This subsector has seen an overall growth in employment over the last decade with some decline being observed since 2013. The subsector is expected to experience some instability over the forecast period as sales of pharmaceuticals overall, and patented medicines is particular, dip while amendments to drug prices raise concerns over loss of jobs and investments.

Although Ontario sales of this subsector have been increasing in recent years, 2017 saw a drop in sales (-2.1%). Additionally, Canada registered only a 2.6% increase in sales of patented drugs between 2015 and 2016, the lowest growth in sales since 2012.<sup>14</sup> This lower growth rate could be further exacerbated by the federal government's proposed amendments to the Patented Medicines Regulations. These amendments will focus on

reducing the cost of patented drugs by modernizing the pricing framework under the Patented Medicine Prices Review Board<sup>15</sup> and are anticipated to cost the pharmaceutical industry approximately \$8.6 billion in lost revenue over the course of a decade.<sup>16</sup> Drug makers have indicated that these amendments could hinder their ability to continue investing in Canada<sup>17,18</sup> and potentially result in significant job loss in the sector.<sup>19</sup>

While patented drugs may have experienced some volatility over the last year, the generic drug market has seen an appreciation in sales and utilization as generics share of drug spending increases, patents on commonly used drugs expire, and governments try to control health care spending in the face of an aging population and increasing prevalence of chronic diseases.<sup>20,21</sup> However, pressures to reduce prices of generic drugs both globally and nationally may create some instability for generics manufacturers over the forecast period.<sup>22</sup> Growth in sales may be particularly affected by the recent development of a five-year initiative by the federal government in partnership with key stakeholders to lower prices of generic drugs.<sup>23,24</sup> On a brighter note, pricing stability and predictability offered by this initiative could potentially lead to increased investment by generic pharmaceutical manufacturers.<sup>25</sup>

The increasing adoption of business models that rely on outsourcing of manufacturing to contract development and manufacturing organizations (CDMOs) offers another avenue of growth for this subsector especially due to its proximity to North American markets.<sup>26</sup> CDMOs should continue to grow as the pharmaceutical industry relies heavily on them to move towards next-generation processing to increase productivity, facility flexibility, and cost efficiency.<sup>27,28</sup> Rising costs to develop and manufacture new drugs as well as competitive pressures are resulting in the integration of outsourcing activities whereby pharma companies and biotech firms are acquiring or merging with CDMOs to expand their portfolio of offerings, gain additional technical expertise, increase access to innovation, and manage risk.<sup>29</sup> These developments bode well for the future of CDMOs.<sup>30</sup> The presence of major CDMOs in Ontario, such as Alphora Research Inc., Patheon, Dalton Pharma Services, and Contract Pharmaceuticals,<sup>31,32,33</sup> could benefit the job market for this subsector.

Biopharmaceuticals (or biologics) are forming an increasing share of the pharmaceutical market in terms of sales<sup>34</sup> and utilization<sup>35</sup> and are driving market growth globally and nationally<sup>36</sup> particularly due to the increasing prevalence and incidence of auto-immune diseases, cancer, AIDS and other diseases. Biopharmaceuticals are thus forming a potential area for growth for this subsector.<sup>37,38,39</sup> Growth could be further strengthened through the expected boom in the biosimilars market following the loss of patent protection for several biopharmaceuticals between 2012- 2019.<sup>40</sup> This should also boost CDMOs as the production of biosimilars may be outsourced.<sup>41</sup> Additionally, the recent revisions to the information and regulatory requirements for the authorization of biosimilars biologic drugs by Health Canada, will harmonize the Canadian approval pathway with other regulatory agencies including the World Health Organization, European Medicines Agency and the U.S. Food and Drug Administration.<sup>42,43</sup> The reduction in costs associated with the harmonization of the approval pathway could potentially support more investment in this subsector in the future.<sup>44,45</sup>

Uncertainties about the future of the North American Free Trade Agreement (NAFTA) may have negative outcomes for the subsector. In 2017, two-thirds of all exports from this subsector went to the U.S.<sup>46</sup> If NAFTA renegotiations result in the closing off of the U.S. market to Canadian exports, the prospects for the subsector would be significantly dampened over the forecast period.<sup>47</sup>

The Canada and European Union (EU) Comprehensive Economic and Trade Agreement (CETA) came into force on September 21, 2017. The subsequent elimination of tariffs on exports bodes well for this subsector. CETA harmonizes Intellectual Property (IP) laws regarding geographical indications, pharmaceutical patents, and trademarks which could potentially increase cooperation and trade between Ontario and EU countries. Additionally, the patent term restoration provision for pharmaceuticals under CETA could boost generic drug

manufacturing by harmonizing Canada's patent system with that of major trading partners.<sup>48</sup> However, the extension on patent terms could slow growth for the subsector by delaying the entry of generic medicines into the market by up to two years.<sup>49</sup> On the flip side, the slowed entrance of generics into the market could benefit holders of patented drugs.<sup>50</sup>

The potential establishment of the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) could support long term growth for this subsector by increasing access to markets which currently make up only about 7.1% of exports from this subsector.<sup>51</sup> The suspension of more restrictive patent term adjustment and restoration and data protection obligations from the original Trans-Pacific Partnership (TPP) could also support manufacturers of generic medicines in the longer term.

Although these trade agreements bode well for the subsector in terms of increasing sales and exports, the impact on employment may be minimal. Over the past decade, Ontario's domestic exports of pharmaceuticals have increased by an average of about 10% per year. However, this increase in exports has not been reflected in increased employment, with subsector's employment remaining relatively constant since 2006.

Growth of this subsector may be tempered by external factors such as increased growth in developing and emerging markets which shifts investment away from developed markets like Canada; lagging market attractiveness of Canada in terms of pricing controls, market access, regulatory requirements; loss of exclusivity of patent products; dearth of new blockbuster drugs; slowing product approvals; efforts to contain costs from payers driving down drug prices; restrictive market access for generic and patent drugs; and uncertainty in drug pricing and FDA user fee programs in the U.S. under the new administration.<sup>52,53,54,55</sup>

### **An export-intensive sector sensitive to changes in trade relationships**

In 2017, Ontario exported over \$18 billion worth of chemicals and chemical products, a decrease of about 14.5% from 2016, accounting for about half of all Canadian exports from this sector.<sup>56</sup> As an export intensive sector, the performance of the chemical manufacturing sector is closely linked to exchange rate fluctuations<sup>57</sup> and the operation of free trade agreements.

The United States is Ontario's main export market for this sector with over three quarters of its exports going to the U.S. in 2017.<sup>58</sup> The U.S. chemical manufacturing sector is the largest producer of chemical products globally, so it is important for Ontario's exports to have preferential access to the U.S. market to stay competitive. The NAFTA has greatly benefitted this sector by lowering the cost of production, increasing economic activity, and bolstering the sector's relevance in the North American manufacturing economy.<sup>59</sup> However, the new U.S. administration's protectionist policies, particularly aimed at the manufacturing sector, and the potential collapse of NAFTA may create some uncertainty for this sector over the forecast period. If additional tariffs are imposed and labour outsourcing is reduced or eliminated, the sector could see fewer new investments and exports. The sector may also face some indirect impacts as industries using chemical goods see a slowdown in sales and. Due to its heavy reliance on exports to the U.S. and deeply integrated supply chains, NAFTA's future will have, by far, the greatest impact on the sector's current and future prosperity.

The U.S. passed the Tax Cuts and Jobs Act (TCJA) in December 2017 which has reduced the U.S. statutory corporate tax rate from 35% to 21% and slashed U.S. marginal effective tax rate (METR) on investment from 28.4% to 18.8% compared to Canada's 20.3%. These changes are expected to significantly raise the competitive edge of the U.S. in relation to Canada. The TCJA, compounded with the potential scrapping of NAFTA, could result in a longer term bleed in capital flows to the U.S. and difficulty in attracting and retaining investment in Canada.<sup>60</sup> Major multinationals in the sector may relocate to the US to take advantage of more

favourable regulatory, tax, and trade policies offered by the Trump administration.<sup>61,62</sup> These conditions could impact employment over the long run.

In 2017, the European Union (EU) accounted for about 11% of exports from Ontario's chemical manufacturing sector.<sup>63</sup> EU tariffs on chemical products were eliminated immediately upon CETA's entry into force on September 21 2017. By creating a familiar regulatory environment, lowering tariffs, and both parties having a highly educated labour force, there is a potential for increased cooperation and trade between Ontario's chemical industry and the EU's. In the long run, CETA is expected to enhance the competitiveness of the sector and potentially increase sales and employment in the sector. Rising demand for specialty and value added products across several areas in the EU market should also provide the sector with new areas for growth.<sup>64</sup> The preferential duty-free access to EU markets afforded by CETA could boost Foreign Direct Investment, and potentially increase the establishment of Ontario operations from countries like US, China, India, and Japan.<sup>65,66</sup>

On January 1, 2015, the Canada-Korea Free Trade Agreement (CKFTA) entered into force giving Canadian exporters preferential access to the South Korean market and the potential to expand Canadian business in emerging markets in the Asia-Pacific region. The chemical manufacturing industry has benefitted from the CKFTA through the elimination/reduction of tariffs on several Canadian chemical products, pharmaceutical, and cosmetics exports in 2015.<sup>67</sup> Since the CKFTA came into force, Ontario has seen export gains<sup>68</sup> with the chemical manufacturing sector posting over \$125 million in exports to South Korea in 2017, a 5.5% gain since 2014.<sup>69</sup>

The anticipated launch of the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) could potentially boost the sector by increasing access to markets in Asia-Pacific and South America which currently make up only about 4.6% of exports from this sector.<sup>70,71</sup> The potential inclusion of the United Kingdom in CPTPP<sup>72</sup> could also benefit the sector by providing preferential access to the UK market that will be lost under CETA post-Brexit.

These agreements could also benefit the chemical manufacturing sector indirectly by enhancing the sales, exports, and competitiveness of several key industries that use chemical goods. For instance, CETA and CKFTA tariff and duties eliminations are expected to boost oil and gas, agriculture, industrial products, plastics, and automotive industries by increasing their exports and making them more competitive in these markets.<sup>73,74</sup> In addition, CETA's provisions, for sub-national procurement, that allow Canada to bid on public contracts in Europe and vice-versa, could further boost Canadian industries such as construction, transportation, and aerospace manufacturing. Gains in these industries should contribute to growth in chemical manufacturing through increased demand. However, there is some indication the CPTPP may adversely affect some sectors, like automotive manufacturing, in terms of employment and investment.<sup>75</sup> This could offset some of the indirect gains to the chemical manufacturing sector.

### **Cleaning up our act: Environmental regulations could create changes in the sector**

Recent efforts to reduce carbon emissions through the cap-and-trade program are anticipated to impact energy intensive sectors and emission intensive and trade exposed (EITE) industries which could face competitiveness pressures from other jurisdictions that do not have similar plans. Chemical manufacturing (specifically basic chemicals, petrochemicals, synthetic fibres, and fertilizers subsectors), an EITE industry, is expected to be particularly vulnerable in this regard.<sup>76,77</sup> Additionally, actions by the new U.S. administration to rescind the Clean Power Plan, could further reduce the prospects of advancing a similar plan south of the border.<sup>78</sup> As Ontario's main trading partner for this sector, this could potentially affect the competitiveness of local firms in relation to their U.S. counterparts who may not be subject to carbon pricing or emission limits.<sup>79</sup>

The US rollback of policies limiting environmental pollution like the Clean Water Act,<sup>80</sup> the “once-in always-in” policy under the Clean Air Act,<sup>81</sup> and several other environmental rules and regulations,<sup>82,83</sup> may further contribute to competitiveness pressures for Ontario in the short-term. However, some of Ontario’s largest companies will receive major exemptions and be given free allowances for the first four years of the program which may offset some competitiveness pressures.<sup>84,85</sup>

The sector may experience changes over the forecast period, such as changes in types of products that are created and marketed, as companies work to adhere to changing environmental regulations.<sup>86</sup> For instance, under the Montreal Protocol and Canadian Environmental Protection Act, Canada has agreed to reduce Hydrochlorofluorocarbons (HCFC) consumption by 99.5% by 2020 with a complete phase out on the import and manufacture of HCFCs by 2030. The implementation of these regulations has resulted in diminishing demand for this chemical and is a major factor in the 2018 closure of the Chemours Canada Company plant in Maitland which produces HCFC-123.<sup>87</sup>

Although there may be potential costs and competitiveness pressures associated with environmental regulations in the short term, businesses committing to greener and more sustainable practices have been found to reduce costs, improve resource productivity and profitability, increase competitiveness, and improve brand loyalty.<sup>88,89</sup> Thus these changes to environmental regulations may strengthen the sector in the long term. Additionally, the focus on environmental sustainability and the reduction of carbon emissions may create new areas for growth such as biofuels.

#### **With great power comes great electricity bills: affordable energy is key to the growth of the sector**

The chemical manufacturing industry is energy intensive requiring large inputs of electricity and feedstocks for production.<sup>90</sup> Some estimates indicate that feedstock and energy costs constitute about 70% of chemical companies’ process costs,<sup>91</sup> making this industry particularly vulnerable to high energy costs.

Ontario has been found to have some of the highest industrial electricity rates in North America and the rates have been on the rise recently. Electricity costs for large industrial consumers increased by 53% in Ottawa and 46% in Toronto between 2010 and 2016. In comparison, the rest of Canada experienced about a 14% increase over the same period.<sup>92</sup> During the same period, small industrial consumers in Ottawa saw their electricity costs increase by 50% while their counterparts in Toronto saw an increase of 48%. In contrast, the average increase across Canada was about 15%. These rates are expected to continue to rise over the forecast period as fixed costs increase, demand for energy falls, and additional costs pressures arise from the introduction of the cap-and-trade program and renovation of nuclear power plants.<sup>93,94</sup> Rising electricity costs in Ontario have been identified as a key concern for this sector<sup>95</sup> as further increase in rates could create a competitive disadvantage in relation to other lower cost jurisdictions, impact future investments in the province, and affect the ability of the sector to grow and provide employment.<sup>96,97,98</sup> However, the recent expansion of the Industrial Conservation Initiative (ICI), which incentivizes large electricity consumers to move their electricity consumption to off-peak periods thus reducing their bills by about a third, could alleviate energy costs for the sector and support growth.<sup>99,100</sup> On the other hand, smaller industrial consumers who dominate the chemical manufacturing sector, are not included in the ICI and may continue to face higher energy costs.<sup>101</sup>

Both natural gas and crude oil are important inputs in chemical manufacturing whether as a fuel source or a feedstock.<sup>102</sup> Natural gas has proven to be a boon to the sector by providing a low-cost input. Key players in the sector are taking advantage of natural gas feedstocks and supporting greater capital investment in the province. For instance, Nova Chemicals is investing \$400 million dollars in upgrading its Corunna plant to create a pipeline to connect to natural gas liquids originating from the US.<sup>103</sup> Natural gas prices are expected to remain low over the forecast period<sup>104</sup> which would decrease the cost of input for the sector and provide an

opportunity for industrial renewal.<sup>105</sup> The potential recovery of crude oil<sup>106</sup> could be a double-edged sword for the sector. While increasing oil prices could raise input costs for subsectors dependent on oil feedstocks,<sup>107,108</sup> the higher prices could increase revenues from petrochemicals and benefit chemical companies supplying oil companies.<sup>109</sup>

### **Opportunities for growth: high expectations of the marijuana industry**

The Access to Cannabis for Medical Purposes Regulations (ACMPR), which came into effect in 2016, expanded the type of cannabis products that can be accessed for medical purposes, creating a new area for growth and investment for this subsector. Companies approved by Health Canada are already engaged in the production of cannabis related drugs and the industry is expanding as evidenced by recent investments in medical marijuana production across the province. In addition, there is some indication that increasing demand for medical marijuana globally will boost exports for the Canadian pharmaceutical industry over the forecast period.<sup>110</sup> Ontario is particularly well positioned to benefit from this trend as major Ontario-based companies such as Canopy Growth Corporation, CannTrust Holdings Inc., Cronos Group Inc., and Aphria Inc. have begun to expand their international footprint and are increasing their international exports.<sup>111,112,113,114</sup> The medical marijuana industry could also receive a boost from efforts by the retail sector to sell medical marijuana in-store, expanding the current online distribution model.<sup>115</sup> Sales for the industry should also be bolstered in the near future as major companies begin to cover medical marijuana in employee benefit plans.<sup>116,117</sup>

The legalization of recreational marijuana in Ontario by the summer of 2018 is expected to create an additional avenue for growth and investment. In anticipation of increased demand, following the legislation, several major companies are expanding their facilities,<sup>118,119</sup> merging or acquiring smaller firms,<sup>120</sup> as well as hiring workers across skill levels.<sup>121</sup> Legalization is also expected to drive the entrance of the big players from pharmaceutical, tobacco, and alcohol industries which may influence which sector will benefit from job creation.<sup>122,123,124</sup> Additionally, the restricted distribution of recreational marijuana through the Liquor Control Board of Ontario (LCBO) is expected to benefit the largest producers as they will be able to supply larger amounts of product at low prices, potentially impacting the growth of smaller producers over the forecast period.<sup>125,126</sup>

The recent rescission of the Cole Memorandum, a federal policy of non-interference in US states where marijuana is legal,<sup>127</sup> could have varying effects on the Canadian marijuana industry. On one hand, Canadian companies may lose access to the U.S. market. Companies with operations south of the border may find it necessary to withdraw from the U.S. as they could be seen to be in violation of TSX listing requirements<sup>128</sup> as well as U.S. federal law that classifies marijuana as an illegal schedule 1 drug.<sup>129</sup> On the other hand, this decision could be a boon as it would suppress the emergence of any large U.S. marijuana companies that could challenge the global expansion of Canadian firms.<sup>130</sup> Also, the decision could potentially drive more U.S. investment<sup>131,132</sup> and tourism<sup>133</sup> north of the border further supporting growth and employment for the industry.

The signing of the Paris agreement in 2015 has renewed federal and provincial efforts to reduce carbon emissions and has further supported the burgeoning bioeconomy in Ontario.<sup>134</sup> This has created new areas for growth, investment, and employment in the chemical manufacturing sector particularly for industries that use biomass to create renewable biochemical and biofuel products. For instance, in 2017, Bioindustrial Innovation Canada (BIC) invested \$12 million in 12 projects involved in developing sustainable chemistry and bio-based innovation which included several chemical manufacturing companies including BioAmber, S2GBioChem, and Origin Materials.<sup>135</sup> These investments are expected to create additional jobs over the forecast period.

Employment in the chemical manufacturing sector should receive a boost from growth and investment in the biofuel industry<sup>136</sup> as production and use increases in tandem with federal and provincial renewable fuels mandates<sup>137</sup> and provincially funded programs support the expansion of the biofuel industry.<sup>138</sup> In addition, the federal government is developing a Clean Fuel Standard<sup>139</sup> while the provincial government has proposed a doubling of the minimum ethanol mandate.<sup>140</sup>

Efforts to diversify the province's manufacturing base into biochemicals are also providing a promising area for growth and employment.<sup>141</sup> The recent establishment of new industries in this area are expected to increase employment in the sector. The biochemicals industry should continue to grow as economic and ecological factors drive change and diversification in other industries.<sup>142</sup> For instance, as the forestry industry seeks to diversify the use of its (by)products, biochemicals may see increases in investment and partnership.<sup>143</sup>

### **Digitization, Automation, and Artificial Intelligence: The changing face of technology in the sector**

Industry 4.0, also known as the "industrial internet of things" or the "digital factory", is defined in many different ways but at its core it can be seen as focusing on digitizing key processes.<sup>144</sup> This can include the digitization of essential functions within the vertical operational structure of a company and/or horizontally along its value chain. It can also focus on the digitization of products, services, business models, and individualized and personalized customer access. Industry 4.0 has been gaining ground in global<sup>145</sup> and local<sup>146</sup> manufacturing sectors due to the potential for providing major competitive advantages including significantly reduced costs especially in labour and energy; increased revenues flowing from integration, new sales approaches, and new digital business models; increased precision, consistency, and quality; increased output and efficiency; and increased relevance in a growing environment of digitally connected smart infrastructure.<sup>147,148</sup>

Over the next five years, the global chemical manufacturing sector, which already boasts a high level of automation, is expected to invest significantly in comprehensive next-generation digitization. While much of this investment will initially be focused on the digitization of operations, the future is expected to bring an extension of such digitization to value chains and production.<sup>149</sup> Manufacturing will advance from using computers to design products and manufacturing processes to using robots to perform various tasks. Big data would then come into play whereby sensors embedded in the production process would allow ongoing analysis of product quality and equipment performance. Finally RFID chips embedded in final products would support effective supply chain management.<sup>150</sup>

There is some indication that while Ontario firms are adopting next-generation digitization, this adoption is only just beginning and does not cover the entirety of operations.<sup>151</sup> Additionally, the extent and speed of adoption may differ from subsector to subsector depending on the type of technology currently available and the level of speciality knowledge and experience required for production.<sup>152</sup> However, Canadian firms may move towards more comprehensive digitization in the near future as they work to flourish in a hypercompetitive, low growth global context where expanding the customer base has become increasingly important. Next-generation digitization has the potential to transform the customer-facing aspect of chemical companies allowing them to be more attuned to individualized customer needs and provide end solutions. For instance, some chemical companies are using digital technologies to track how their products are being used in their customers' operations, allowing them to gauge utilization patterns to improve their products and proactively address the needs of the customer.<sup>153,154</sup>

Artificial Intelligence (AI) is becoming important for both digitization and growth of the sector. AI's ability to discover chemical synthesis is particularly significant in the pharmaceutical subsector as it can reduce the time required for drug discovery and development, and by extension, reduce costs.<sup>155,156</sup> In the wider chemical

industry, the application of AI has the potential to make chemical processes safer, increase efficiency, boost productivity, optimize process technology, reduce waste, and reduce energy consumption.<sup>157</sup>

In recent years, nanotechnology has emerged as a new frontier for growth in chemical manufacturing due to its ability to address multiple areas of concern for the sector including expansion of its product base, decreasing environmental impact, and increasing efficiency and durability of its products and processes. The growing use and applications of nanotechnology in various chemical manufacturing fields including cosmetics and personal care products,<sup>158,159,160</sup> agricultural chemicals,<sup>161</sup> and paints, coatings, and adhesives<sup>162,163</sup> could create new areas for product development and expansion, particularly in relation to the development of sustainable and more environmentally friendly chemical products. The pharmaceuticals manufacturing subsector is at the forefront of much innovation with nanotechnology not only being applied in the development of new drugs and therapies<sup>164</sup> but also in new drug delivery methods,<sup>165,166,167</sup> tissue engineering,<sup>168</sup> medical imaging, diagnostics, and targeted therapeutic devices.<sup>169</sup> The subsector could see significant growth where new areas of pharmaceutical development meet nanotechnology based innovation. For instance, the increasing applications of marijuana for medical purposes are getting a boost from nanotechnology based innovations that could better deliver marijuana doses.<sup>170</sup>

### **Sector Outlook: Modest growth expected for the chemical manufacturing sector**

Provincial employment in the chemical manufacturing sector is expected to increase by an annual average of 0.9% over the forecast period. Modest growth is expected over the forecast period due to potential new investments in the province, some increase in exports encouraged by new trade deals, growth in sales for some subsectors and improvement in industries using chemical inputs. Growth may be moderated by volatility in energy prices, exchange rate fluctuations, environmental regulations, and changes in NAFTA.

### **Sub-provincial trends**

Ontario's chemical manufacturing sector is concentrated in several regions including Toronto, Windsor-Sarnia, Hamilton- Niagara Peninsula, and parts of Eastern Ontario.

In 2016, the **Toronto** economic region accounted for over half of the province's employment<sup>1711</sup> and more than half of the province's establishments for the chemical manufacturing sector.<sup>172</sup> Toronto also boasts the largest pharmaceutical cluster in both the province and Canada with some of the major global pharmaceutical manufacturing companies operating here.<sup>173</sup> Recent investments to expand pharmaceutical manufacturing in Toronto include combined investment from Bayer and Versant Ventures to launch Bluerock Therapeutics,<sup>174</sup> federal funding for Contract Pharmaceuticals Ltd Canada,<sup>175</sup> and provincial funding to Biolab Pharma Ltd and Apotex Inc.<sup>176,177</sup> The sector is expected to experience some instability as Teva Pharmaceuticals advances with the announced cuts to its global workforce which include its operations in the Toronto region.<sup>178</sup> However, new investments combined with growth in the wider life sciences sector in the region<sup>179</sup> should offset some of these losses and continue to support job growth in this sector.

The **Windsor-Sarnia** region is the major hub for the chemical industry with the Sarnia-Lambton area providing the most integrated chemical cluster in the country.<sup>180</sup> This area is at the center of the burgeoning biochemical and biofuel industry<sup>181</sup> and is seeing new investments and expansions by major manufacturers including S2G Biochemicals Inc.,<sup>182</sup> Origin Materials,<sup>183</sup> Advanced Chemical Technologies,<sup>184</sup> Comet Biorefining Inc.,<sup>185</sup> and BIOX Corporation<sup>186</sup> over the forecast period. Nova Chemicals recent \$2 billion capital investment<sup>187</sup> in the Sarnia area should further bolster job growth in the sector over and beyond the forecast period.

The **Hamilton-Niagara Peninsula** made up about 11% of the provincial chemical manufacturing establishments<sup>188</sup> and a little less than 10% of employment.<sup>189</sup> The ongoing recovery of the manufacturing

sector in region,<sup>190</sup> recent investments,<sup>191,192</sup> and a growing marijuana industry in the region<sup>193,194,195</sup> should provide some employment gains over the forecast period. Proximity to growth in the GTA should assist the regional manufacturing base and support this sector.<sup>196</sup>

The traditional chemical manufacturing sector in the **Ottawa** region has seen somewhat of a decline in recent years. This trend is expected to continue over the forecast period as Procter & Gamble announced that it will be closing its Brockville plant by the end of 2020, affecting 480 workers<sup>197</sup> while 37 workers will lose their jobs as Chemours Canada Company shuts its Maitland operation by December 2018.<sup>198</sup> However the sector may receive a boost from the investments in marijuana production in the region.<sup>199,200</sup>

**Note:** In preparing this document, the authors have taken care to provide clients with labour market information that is timely and accurate at the time of publication. Since labour market conditions are dynamic, some of the information presented here may have changed since this document was published. Users are encouraged to also refer to other sources for additional information on the local economy and labour market. Information contained in this document does not necessarily reflect official policies of Employment and Social Development Canada.

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<sup>1</sup> Statistics Canada, Labour Force Survey

<sup>2</sup> Invest in Ontario. Chemical/Biochemical. Retrieved January 10 2018 from <https://www.investinontario.com/chemical-and-biochemical>

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