

## **IA North America : Canada- Ottawa / Arie Plieger**

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*Canada has in the perception and analysis of the Diplomatic Network undeniable potential in the framework of the "Knowledge and Innovation Agenda" for the top sector Chemistry. Together with the Innovation network in Washington and Boston focus for 2016/7 and beyond is to raise awareness for innovation, research and development potential of Canada in the framework of roadmaps in force for Chemistry top sector. Chemistry sectors both in Canada and the Netherlands are directly linked to various fields of research, innovation and development. In this article we focus on relevant research developments in Canada and innovation in the areas of polymers, bio energy, "Canadian light source" and catalysis research and innovation.*

### **Canada**

#### ***Brief overview of the importance of Chemistry Industry Sector for the Canadian economy in general:***

Chemistry as a sector is vital to the Canadian Economy and is working hard to reduce its carbon footprint. Nowadays a Canadian Chemical product is manufactured with 88 per cent fewer emissions than at the end of the century. The industry sector transforms successfully raw materials like natural gas liquids, oil, minerals, electricity and biomass into building blocks needed to manufacture more than 70,000 products, from vehicles, building materials to pharmaceuticals. The sector relies on feedstock from oil and gas, electricity, mining and biomass sectors and is also poised for growth, with potential to attract more than 10 billion in new investment over the next decade. Canada's nearly CAD 50 billion chemistry industry operates in every province, with key clusters in Ontario, Alberta and Quebec.

**Ontario** is Canada's largest chemical-producing province – its \$24-billion chemistry industry has major operations among others in Sarnia and the Greater Toronto Area. Seven of the *world's largest chemistry companies operate in Ontario*, and the industry manufactures products spanning the entire value-chain: from specialized polymers to alternative fuels, lubricants, paints, adhesives and buildings blocks for high-tech fabrics and other goods.

**Alberta** is home to Canada's second-largest chemistry cluster – a \$13-billion industry, with key manufacturing facilities located around Fort Saskatchewan and Joffre. Alberta's chemistry industry produces a variety of petrochemicals, including methanol, ethylene, polyethylene, ethylene glycol, propylene and styrene.

**Quebec** is home to Canada's third-largest chemistry cluster, with facilities predominantly located in the Montreal area. Quebec's \$9-billion chemistry industry produces a wide range of products, including electro chemicals, aromatics, paints, coatings and adhesives.

The federal government of Premier Trudeau recently announced to invest CAD 491.8 million over the next five years to continue delivering on Canada's world-leading Chemistry sector and it's growing ambition to be an international frontrunner with regards to global ( and Canadian) challenges of the future. Canada's chemistry industry remains overwhelmingly committed in working with the Government and stakeholders to ensure the objectives regarding sustainability in the framework of the international climate objectives. Today, *more than 95 per cent* of all manufactured products in Canada rely on chemistry.

### **Polymers**

DPI (Dutch Polymer Institute) is an international collaborative platform for industrially relevant research in the field of polymers. DPI today is a widely recognized- also in Canada- independent institute that specializes in bringing together industrial needs and academic capabilities in a world-class pre-competitive research program. In an fast changing environment of global challenges and shrinking research budgets in the Netherlands Canadian developments in the sphere of polymers are essential and in the view of the Diplomatic Network important for establishing Canadian Dutch public private partnerships and a polymers platform.

Since the industry in Canada is characterized by a large number of SMEs, there is a need for collective initiatives to foster greater use of technology as a means for enhancing (international) competitiveness. Government support in the area of R&D was provided to many of these organizations during their start-up phase. Within the federal government, the main R&D thrust related to the plastics industry is from the National Research Council. The Industrial Materials Institute has the largest group dedicated to plastics. Other significant research efforts are conducted by the Institute for Chemical Process and Environmental Technology and the Institute for Research in Construction. On a provincial level, two provincial research organizations have programs supporting the plastics industry: the Alberta Research Council and the Centre de Recherche Industrielle de Québec. In Ontario, there is a provincial Centre of Excellence called Centre for Materials and Manufacturing which brings university researchers and companies with technical needs together. Plastics are one of its areas of focus. In addition, a number of universities have faculty members or research groups that are active on plastics projects. These include the universities of *British Columbia, Alberta, Calgary, Western Ontario, Waterloo, Toronto, McMaster, Queen's, Ottawa, McGill, the École Polytechnique, Laval, Concordia and Moncton*. The research programs conducted within the universities are often co-funded by industry and National Government.

### **Specifics on Universities and innovative approaches**

The **University of Waterloo's Institute for Polymer Research** (IPR) has earned an international reputation for making research initiatives pay off for a wide variety of companies. These technological initiatives have been instrumental in the development of better polymers for wire and cable applications, polymer modifications to make heat- and oil-resistant rubber, new polymer alloys and blends, systems for recycling polyolefin containers, the computer design of extrusion screws and dies and computer modelling and control of polymerization processes. The Institute, made up of faculty members in chemical engineering and chemistry and representatives of major companies, has become one of North America's leading centers of polymer expertise devoted to creating an imaginative, results-oriented program of graduate studies and research in experimental polymer science and engineering. The Institute carries out applied and fundamental research in areas that are of vital interest to the plastics, coatings, adhesives and elastomers industries. This includes work in such diverse fields as molecular weight characterization, thermal characterization, emulsion polymerization, polymer processing, polymerization kinetics, copolymerization, reactive extrusion, polymer-based catalysts, polymer photochemistry and development of new monomers and polymers.

**Chemists at the University of Toronto** have developed a new battery that stores energy in a cathode derived from vitamins. This breakthrough could eventually lead to batteries that are much cheaper and more environmentally friendly than regular lithium-based batteries, but with similar performance. This development marks the first time a bio-derived polymer has been successfully applied to battery technology, an accomplishment that could unlock a new path for the future of energy storage. A new material from vitamin B2 was created that begins with genetically-modified fungi and, through a semi-synthetic process, links two flavin units to create a long-chain molecule (in other words, a polymer). The bio-derived polymer makes it possible to create a truly green battery that has both high capacity and high voltage, which are both key elements to running all the portable electronic devices that modern life has come to rely upon.

Advanced Materials and Polymers in **Montreal at Mc Gill, Laval and Concordia**. These universities have an internationally recognized research program in structural, functional, and biological materials, spanning synthesis, characterization, processing, modeling activities, with strong links to academic, government, and industrial research centers. Areas include plasma processing (eg. nanofluids, carbon nanotubes, advanced coatings) and polymeric or "soft" materials research (eg. self-assembling or structured materials, complex fluids, liquid crystals, colloids and soft composites and novel polymerization methods). Applications of the research are targeted towards the development of next-generation high-density storage media, functional coatings, electronic devices, composite fluids and "smart" materials. In 2014 the Montréal's École Polytechnique the largest university research centre in Canada on polymers and polymer matrix composites for industrial applications: the Centre de recherche en plasturgie et composites (CREPEC) was established

Due to Industrial relevance and internationally recognized scientific quality *Universities in Waterloo, Toronto and Montreal* would be excellent partners for Dutch Polymers Initiatives and research.

National Research Council supports development and demonstration of new composite materials and technologies which will make methods of transport and mobility lighter, stronger and greener, as well as more reliable and easier to maintain. The aim of NRC is the development, advancement and demonstration of cutting-edge technologies that have the potential for significant cost-savings while maintaining high levels of quality, reliability and performance.

### ***The Canadian Light Source.***

Over the past two decades there has been tremendous growth in applications of synchrotron light to all branches of science and technology, particularly in chemistry.

Synchrotron light is an accelerator-based light source that covers the complete electromagnetic spectrum from infrared to hard X-ray. It is intense, fully tunable, highly polarized, and has a picosecond time structure. Annually, more than 20,000 scientists from many disciplines - though predominantly physics and chemistry.

The CLS was established with financial support of a Canada Foundation for Innovation national facility grant and is directly involved in relevant sectors in Canadian Industry, like mining and environment, pharmaceuticals, oil and gas, aerospace and energy storage.

Participation in CLS from essentially every university in Canada. Canadian light Source is Canada's national center for synchrotron research and is at present a global leader and a recognized center of excellence in synchrotron science and its applications. The center is located in Saskatoon and is considered worldwide as a highly advanced research tool that generates intense beams of brilliant light needed to view the microstructures of materials. Objective is innovation in industrial science solutions in advanced materials. For the next generation surface coatings and lubricants, synchrotron research is a key tool in among others aerospace industrial research (strong cluster in Montreal).

*CLS is the largest science project in Canada in the last 30 years.* The CLS is Canada is the driver of change and innovation with among others strong focus on Chemical characterization of metallic glasses, alloys and carbon composite materials, 3-D structure determination for non-destructive analysis of electronic packages, development of new materials for diverse applications ranging from *faster computing to energy storage* and last but not least characterization of ceramic coatings on jet engine components at operational temperature.

Partners in Canada: <http://www.lightsource.ca/pages/partners.html>

Innovation network in Washington, Ottawa and Vancouver can support interested partners in the Netherlands to establish (in) direct links with CLS.

### **Bioenergy**

Bioenergy is a renewable energy resource derived from living organisms and/or their by-products. It currently accounts for approximately 6% of Canada's total energy supply. Bioenergy is an extensive sustainable energy resource that can supply energy to Canada while emitting low CO<sub>2</sub> and reducing waste.

Canada's National Research Centre research focuses on the conversion of biomass to energy and fuels that can be used to meet energy needs in industry, transportation, agriculture and residential heating. Through collaborations with industry and in-house research, NRC is exploring biogas (gasification and anaerobic digestion), biofuels (2nd generation biofuels and pyrolysis), biomass resources (biomass to gas, catalytic conversion and biomass densification), combined heat and power and air emissions reduction. While Canada possesses large amounts of potential feedstock for bioenergy, the country is somewhat stuck in moving forward as traditional fuel prices have collapsed, which makes it harder to find the business case for bioenergy, unless the government introduces price subsidies. The bio energy sector is pushing for more government support to make the transition to cleaner energy. Nevertheless, research continues. There is a small number of ethanol (mostly from corn) and biodiesel (mostly from multi feedstock and yellow grease) plants in Canada producing 2000 and 650 MMlly (million liters per year) respectively.

### Opportunities: Energy Innovation Program (EIP)

Natural Resources Canada recently launched the new Energy Innovation Program (EIP). (<https://www.nrcan.gc.ca/energy/science/programs-funding/18876>). The program's objective is to support energy technology innovation to produce and use energy more cleanly and efficiently. Proposals are being requested in several strategic priority areas, including "Improving industrial efficiency" with bio refineries or integrating next generation bioenergy technologies into existing assets.

Applicants must first submit an information form, after which they will be provided with the proposal guide and template. The complete proposal is due on October 31, 2016. It is expected that further funding will become available under the Liberal government.

BioNB (New Brunswick) is actively searching for partners recognizing that the potential in New Brunswick, with its vast forests and wood waste from logging and paper mills, is not fully explored. Technology to upgrade biomass to higher values is not up to par and could benefit from Dutch knowledge and technology. It is worth looking into the Eurostars program (<https://www.eurostars-eureka.eu/>) for support.

For further reading: [http://www.fpac.ca/wp-content/uploads/2014\\_CanBio\\_Report.pdf](http://www.fpac.ca/wp-content/uploads/2014_CanBio_Report.pdf)

### **Catalysis Research and Innovation**

On the basis of existing contacts between the Embassy in Ottawa The University of Ottawa's Centre for Catalysis Research and Innovation (CCRI) is an excellent example of a multidisciplinary center working to achieve excellence in catalysis research on a global scale. The CCRI includes some of Canada's top researchers, globally recognized leaders in the areas of homogeneous and heterogeneous catalysis. Through world renowned expertise, state-of-the art facilities and partnerships with leading institutes around the globe, the CCRI provides international partners with a unique scientific environment that fosters groundbreaking research.

In Canada the role of catalysis research as a major driving force for global challenges and maintaining high standard of living enjoyed by knowledge-based societies. *The value of catalysis to the North American economy is estimated to be US\$1 trillion annually.* In Canada catalysis is involved in 80 current chemical processes, cutting a broad swath across the fuels, polymers, materials and pharmaceutical industries.

From May 28-June 1, 2017 Toronto will host the 100th Canadian Chemistry Conference and Exhibition. Excellent opportunity for interested partners in the Chemistry sector in the Netherlands to learn about developments and catalysis research. If there is enough interest from partners in the Netherlands the IA network in collaboration with CG Toronto and the Embassy in Ottawa contemplates establishing a booth at the Conference.

Over the last decade CCRI established partnerships and collaborations with leading catalysis research institutions and industries. CCRI has already established formal partnerships with the Berkeley Catalysis Centre (BCC) and the Netherlands Institute for Catalysis Research (NIOK). Important partnerships with industry are ongoing, such as: pharmaceuticals (Merck Frosst, Bristol-Meyers, Boehringer-Ingelheim, Astra-Zeneca, Pfizer, **DSM**), chemical (Dow, Sasol, Nova Chemicals) materials and gas separations (Rohm & Haas, Questair, Materia, Cargill) and biocatalysis (Iogen).

Embassy Ottawa was in contact with Natural Sciences and Engineering Research Council of Canada (NSERC) and the National Research Council of Canada (NRC) regarding "chemie uitvraag" and National Ultrahigh-Field NMR Facility for Solids is considered a frontrunner and was recommended for possible interested Chemistry partners in the Netherlands. This relatively new facility is seen as the most cost-effective way to provide the Canadian NMR community access to a world-leading NMR facility for advancing the science of materials and the innovative development of technologically advanced products. Funding for the establishment of the facility has been arranged through CFI, provincial agencies (Ontario Innovation Trust, Recherche Québec), Bruker Canada and NRC.