Chemistry Industry Association of Canada
canadianchemistry.ca

Association canadienne de l'industrie de la chimie
chimiecanadienne.ca

Water Usage in the Chemistry Industry of Alberta

Current sector water usage & Opportunities for Conservation, Efficiency and Productivity

2012

1. Overview of CEP Sector Plan

Water is an integral part of life, as we rely on it to maintain human health, as wildlife habitat, for food production, industry and for transportation. The chemistry industry uses water in many ways in their operations and products. As part of Responsible Care, members are committed to being responsible stewards of water resources and for managing their business operations to conserve and minimize water use, prevent incidents that would be detrimental to water quality or quantity, and to control effluent streams to protect water bodies, groundwater and habitat. This is consistent with and supports Alberta's '*Water for Life'* Objectives. This document was developed in response to the Alberta Water Council's September 2008 "*Recommendations for Water Conservation, Efficiency and Productivity Sector Planning*" initiative for the seven identified priority sectors to develop a Conservation, Efficiency and Productivity (CEP) Plan.

This chemistry and petrochemical CEP plan focuses on the province wide water use by our industry sector and identifies what steps the industry has taken toward responsible water use and also looks at future opportunities for conservation, efficiency and productivity. Consistent with Alberta's *Water for Life* strategy, our industry sector supports the need for reliable, quality water supplies for a sustainable economy, while maintaining safe, secure drinking water supply and a healthy aquatic ecosystem.

Richard Paton, President of Chemistry Industry Association of Canada in January of 2012 reflected on CIACs history, as the association celebrated 50 years as the voice of Canada's chemistry industry, as follows:

> "CIAC started in 1962 as the Canadian Chemical Producers' Association, with a small group of companies located in Quebec and Ontario. Like most business associations, CCPA's exclusive purpose was to deal with economic issues. However, as the chemistry industry evolved over the next two decades, it faced a number of domestic and international safety incidents, (including the infamous Mississauga train derailment) which forced the association to rethink its "raison d'être".
>
> The reality was that the public did not trust the chemistry industry. Recognizing that, in 1985, Canada's chemistry CEOs began developing **Responsible Care®**– an industry-led responsibility initiative. CCPA became the first Canadian business association to require its members to commit to a set of principles as a condition of their membership. Responsible Care required members to do the right thing, and ultimately, to be seen to be doing the right thing through public verifications.
>
> Creating Responsible Care represented a major shift in how business associations operated, and over the last 27 years, our association's approach has been emulated by organizations in Canada and around the world. Within the global chemistry industry, the Canadian Responsible Care model has been adopted in 60 countries.

Of course, both Responsible Care and CIAC's membership requirements have evolved considerably since 1985. We now require our members to report their emissions annually, and to commit to continuously improving their environmental and safety performance. This approach has produced significant results – since 1992 (CIAC's first year of mandatory reporting) our members have eliminated 98 per cent of their emissions for 14 high-priority substances targeted by Canada's Chemicals Management Plan. Reduced the global warming potential of their operations by 66 per cent, and decreased the ozone-depleting potential of their operations by 92 per cent. Today, a unit of chemical product produced by a CIAC member company is manufactured with 89 per cent less emissions than in 1992 – a remarkable achievement.

Furthermore, CIAC members are leaders in workplace safety, and have dramatically improved their record over the last two decades. In 1990, there were 3.2 injuries or illnesses reported for every 100 member-company employees, but in 2008, that number had been reduced by more than 60 per cent, to 1.19.

CIAC has a long track-record of performance, which gives us credibility when trying to influence policy, or advocate on behalf of Canada's chemistry industry. But our members never like to rest on their laurels. In 2010, our Board made the decision to become the first chemistry association in the world to integrate the concept of sustainability into Responsible Care's ethic, principles and verification approach. This further solidified CIAC's stature as the global leader of Responsible Care. And the Board went even further. That same year, it voted to change our name to the Chemistry Industry Association of Canada, and revised the association's role and mandate to better reflect Canada's modern industrial chemistry value chain."

1.1 Goals and Objectives of CEP Sector Plan

Water use in the chemistry industry involves pumping it from the source, cleaning to make it suitable for use in the process, and subsequent treatment of water prior to discharge of the effluent to the water course. This overall process requires significant energy and for competitive reasons, our industry sector, especially in the last 20 years, has spent a considerable effort looking for ways to reduce energy, make use of the resource component more efficient and enhance productivity. Some 50 years ago water availability for the most part was taken a lot more for granted. More recently our appreciation of the importance of this essential resource has grown and even brief periods of drought have taught us that water conservation, and greater efficiency in its use, need to be part of our documented stewardship of our natural resources. Performance measurement has become the way in which we measure and track progress towards targets, and as such welcome accountability and demonstrate commitment to the goal or objective. CIAC, over the last 19 years, through the annual publication of the 'Reducing Emissions' report has demonstrated its commitment to Responsible Care, openly and available to the public.

The goal of the Chemistry sector CEP plan is to reduce the volume of water used and as such preserve and conserve water as a valuable resource. But it goes beyond that to document individual company successes in efficiency measures (big or small), and if the chemistry industry increases its production capacity significantly to show how the industry has been able to enhance productivity (that is volume or weight of product per cubic meter of water used). The objective is to be able to demonstrate and document positive results in implementing in all three aspects of CEP.

1.2 Scope of Plan

It should be recognized that this sector CEP Plan does not purport to cover all of the potential industrial water users generally considered in some categorizations as chemical or petrochemical facilities, but it represents the majority of large facilities in Alberta. Water usage by the fertilizer industry, which is represented nationally by the Canadian Fertilizer Institute (CFI) is not included in this consideration.

This report also recognizes that for specific watershed regions, Alberta Environment and Water has initiated significant studies, gathered a scientific data base on river flows and water quality, and is already well underway in implementing some of the CEP goals enunciated by the Water Council. Those specific watershed region initiatives cover all water users and discharges to the river. A key example of such initiatives by Alberta Environment and Water is the 'Water Management Framework' (WMF) for the Industrial Heartland and Capital Region, surrounding the use of the North Saskatchewan River, and as part of Alberta Environment and Water's Cumulative Effects Management Framework. The water user sector CEP plans should assist in evaluating overall water management on a provincial or watershed basis.

Although the Water Council recognized that the current water use of the chemical and petrochemical sector is relatively small, the sector is concentrated in specific watersheds in Alberta where its impact may be larger and may increase with potential industry growth over the next 10-15 years. The chemical and petrochemical sector as considered by the Water Council includes the members of the Chemistry Industry Association of Canada (CIAC) – formerly the Canadian Chemical Producers' Association (CCPA) – and the Canadian Petroleum Products Institute (CPPI). This document represents the CEP Plan for CIAC, and although being part of the sector considerations, it is independent of the CEP Plan for the CPPI

1.2.1 Chemistry Industry Association of Canada

The Chemistry Industry Association of Canada (formerly the Canadian Chemical Producers' Association – CCPA) is the voice of Canada's business of chemistry. The Association represents over 50 companies and Responsible Care® partners ranging from five to 5,000 employees that operate in the chemistry industry.

Member companies are responsible for some 200 sites across the country that produce basic chemicals and resins for manufacturing processes, as well as provide technology, services, marketing and research and development for chemical products. The chemistry industry is positioned at the crossroads between Canada's resource base – including mining, forestry, agriculture and oil and gas – and Canada's manufacturers, including the food and beverage sector, construction, plastics and rubbers, textiles and clothing, electrical and electronics and transportation equipment.

Together, the companies of the Chemistry Industry Association of Canada generate revenues of more than $26billion annually, accounting for the majority of chemical industry operations in Canada.

The Association was created in 1962 and renamed in 2009 to better reflect the changing nature of this dynamic industry. In 1985 the Association adopted Responsible Care® as its operating ethic, and since 1992 provided detailed annual industry emission data to the public in the 'Reducing Emissions' report. The Association has three main objectives: be competitive, be responsible and be credible. Through these objectives, and governed by an active member-base, the Association has developed a strong reputation as a pragmatic, policy based, problem-solving organization. It represents members' interests based on solid analysis. The Chemistry Industry Association of Canada works cooperatively with governments and other groups to find solutions that benefit both Canadian society and the nation's chemical industry.

CIAC membership in Alberta varies from smaller distribution centers of large multi-national companies to large petrochemical manufacturing complexes, with several world-scale manufacturing facilities. In addition several of our member companies provide important services to other industry sectors such as oil sands and oil & gas. Carbon based organic chemistry products account for a large volume of our industry products, but several member companies focus on inorganic products, such as water treatment chemicals. Consequently the products and services of the chemistry sector are among the most varied of any industry sector.

CIAC encompasses both petrochemical and inorganic manufacturing. Petrochemical facilities take ethane (Natural gas liquids) as feedstock and in high temperature furnaces, crack the ethane into ethylene, which in turn allows the production of quite a large number of important derivatives, as illustrated in the diagram below. Inorganic chemical manufacturing uses a variety of feedstock such as acids, salts, etc. and for the electrochemical industry electricity is the key feedstock component.

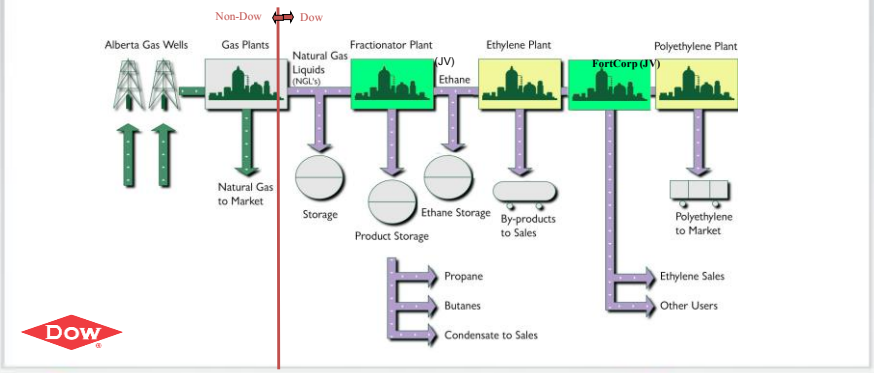
Since chemical manufacturing reflects a value added chain where the product of one facility becomes the feedstock of the next chemical manufacturing facility or a byproduct of one can be used by an adjacent facility, chemical manufacturing clusters have developed, as witnessed by some huge chemical manufacturing clusters globally. The synergies of such clusters have significant utility benefits, including water and waste water treatment and have a significantly lower environmental impact than a collection of individual facilities. The Joffre and Ft. Saskatchewan areas represent chemical manufacturing clusters on a relatively lower scale than other large global areas, but also realize some cluster benefits

Value-Added Manufacturing of Alberta's Resources

Chemistry = Solutions

return to Main menu

Hydrocarbons Products



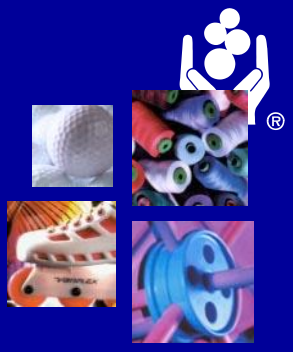
Chemistry Industry Association of Canada

Responsible Care®
Our commitment to sustainability.

Ethylene Chain

Natural Gas → Ethylene

- Low Density Polyethylene and Linear Low Density Polythylene → Food Packaging, Toys, Housewares
- High Density Polythylene → Crates, Drums Plastic Bottles Construction materials
- Ethylene Dichloride → Vinyl Siding, Window Frames, Swimming Pools, Pipes
- Ethylene Oxide → Automotive Chemicals; Carpets, Clothing Nylon; Packaging, Film
- Ethylbenzene → Styrene → Insulation, Styrofoam products; Instrument Lenses, Housewares; Tires, Automotive parts; Paper products, Coatings
- Linear Alcohols
- Vinyl Acetate



World scale manufacturing facilities generate huge product volumes and thus require a good logistics infrastructure to transport the products to market. The chemistry sector accounts for a very significant portion of the Alberta export market and is a stable long term community support and employment asset.

Major CIAC member company water users in Alberta

North Saskatchewan River Basin

Dow Chemical Canada ULC – Fort Saskatchewan
Celebrating 50 years of operation in 2011, the Fort Saskatchewan manufacturing location is situated on 2128 acres. The Fort Saskatchewan site forms one of the largest petrochemical complexes in Canada. Dow has world-scale production units that produce hydrocarbons, ethylene, polyethylene, and electricity, as well as an ethylene glycol/ethylene oxide plant operated by MEGlobal, a 50/50 joint venture between Petrochemical Industries Company (PIC) of Kuwait, a wholly owned subsidiary of Kuwait Petroleum Corporation and The Dow Chemical Company.

MEGlobal – Fort Saskatchewan
MEGlobal operates the FS1 Ethylene Oxide/Ethylene Glycol (FS1 EO/EG) plant in Fort Saskatchewan, at the Dow Chemical Canada site. The FS1 EO/EG plant is one of the largest producers of ethylene oxide and glycol in Canada and started up in 1979.

Shell Chemicals – Scotford
Shell Chemicals Scotford is part of a joint chemical/refining site, called Scotford Manufacturing, with an adjoining Bitumen Upgrader. While the Shell Manufacturing facility produces the full range of fuels for the Western Canadian market, the products of the chemicals facility are styrene monomer and monoethylene glycol (MEG)

Styrene monomer is used in the manufacture of commercial and consumer products such as cassette/CD cases, food containers, home insulation, safety helmets, and car interiors.

Monoethylene glycol is used in the manufacture of polyester fibers, plastic drinking bottles, adhesives and inks.

Several other CIAC member companies operate in the North Saskatchewan River basin, but most of these are relatively low water volume users and rely primarily on municipal water supply.

Chemtrade
Chemtrade has two production facilities in Ft. Saskatchewan, where sulphuric acid and SO2 are upgraded to produce aluminum sulphate (alum), sodium

bisulphate, carbon disulphide, and hydrogen sulphide. Chemtrade also owns and operates a portion of the environmental compliance facilities at the Syncude Canada coker. The emission control system utilizes a waste ammonia stream and Chemtrade technology to scrub emissions and produce granular ammonium sulphate fertilizer as a value added by-product.

Evonik Degussa
Evonik Degussa Canada Inc. is the Canadian subsidiary of Evonik Industries, a global leader in the business of specialty chemicals. Evonik employs more than 34,000 people and is active in over 100 countries around the world. The Hydrogen Peroxide production facility at Gibbons, Alberta started production in 1991 and employs approximately 50 people. The Gibbons plant is one of the largest H2O2 plants in North America with an annual capacity of over 90,000 tonnes. Evonik demonstrates a strong commitment to its neighbours and to the environment through its Responsible Care and Environment, Safety, Health, and Quality Policies.

Celanese
Celanese EVA Performance Polymers, the specialty polymer business of Celanese, is a leading North American manufacturer of a full range of EVA Copolymers and specialty resins. The plant is located in east Edmonton

Newalta
Newalta provides cost-effective solutions to industrial customers to improve their environmental performance with a focus on recycling and recovery of products from industrial residues. A company that has expanded tremendously over the past 10 years, operates 85 facilities across Canada, successfully re-refining used oil, offering industrial waste management and environmental services, effectively recycling lead, and helping to develop new ways to recover value from waste streams and helping to develop new markets for recycled and refined products.

Red Deer River Basin

MEGlobal – Prentiss

Located in the heart of central Alberta near Red Deer, Prentiss is home to two world-scale ethylene glycol plants operated by MEGlobal and a world scale polyethylene plant operated by Dow Chemical Canada ULC. The Prentiss I Ethylene Oxide/Ethylene Glycol (EO/EG) plant started up in 1984. The Prentiss II EO/EG plant started up in 1994.

Dow Chemical Canada ULC- Prentiss
Dow operates a polyethylene plant at the MEGlobal Canada Prentiss site. The LP-7 plant started up in 2000.

INEOS Oligomers – Joffre

INEOS Oligomers' LAO plant at Joffre, Alberta, began operations in 2001. A 250,000 metric ton per year facility, it incorporates world-leading, proprietary technology in the production of linear alpha olefins (LAO). The plant is adjacent to the NOVA Chemicals petrochemical complex, which provides various utilities and services for the LAO plant.

LAOs are used in the production of polyethylene, as intermediates for the manufacture of linear plasticizers for polyvinyl chloride, as raw material to manufacture polyalphaolefins for synthetic lubricants, as a building block for the production of biodegradable surfactants and for a host of other intermediate and final products.

NOVA Chemicals – Joffre

NOVA Chemicals' Joffre manufacturing facility lies just east of Red Deer, Alberta and is one the largest ethylene and polyethylene production complexes in the world. The site consists of six manufacturing facilities: three for ethylene production, two for polyethylene production and a cogeneration power plant.

Joffre's first ethylene plant started production in 1979 and was the first manufacturing facility built by NOVA Chemicals. A second ethylene plant and a polyethylene plant began production in 1984.

In the year 2000, NOVA Chemicals started up a third ethylene plant, as part of a joint venture with DOW Chemical, that nearly double Joffre's ethylene production, taking it to 2165 kilotonnes annually. A 450-megawatt gas-fired cogeneration power plant was added to the site in 2001. The cogeneration plant is a joint venture with ATCO (facility operator), NOVA Chemicals and Capital Power. In 2001, NOVA Chemicals started up a second polyethylene plant.

Since 2009 NOVA Chemicals Joffre site has been recognized by Alberta Environment as an '*EnviroVista Leader',* one of only a handful of Alberta facilities honored in recognition of outstanding performance that exceeds the expectations of the province's environmental legislation and demonstrates responsibility, stewardship and an ongoing commitment to improving environmental performance

Peace/Slave Lake River Basin

ERCO Worldwide – Grande Prairie
Celebrating 20 years of operation in 2012, ERCO Worldwide operates a sodium chlorate plant in Grande Prairie. Sodium chlorate is a raw material in the production of chlorine dioxide, an environmentally friendly bleaching agent used in the production of pulp and paper.

Since 2005, the Grande Prairie site has been recognized by Alberta Environment and Water as an '*EnviroVista Leader*', one of only a handful of Alberta facilities honored in recognition of outstanding performance that exceeds the expectation of the province's environmental legislation and demonstrates responsibility, stewardship and an ongoing commitment to improving environmental performance.

1.3 The Case for Water CEP

The key case for CEP to the chemistry sector is that it demonstrates commitment to sustainability. In 2010 CIAC integrated sustainability into Responsible Care, and the CEP provides a way to document Responsible Care in action.

1.4 CEP Plan Champion and Leaders

Individual member companies are ultimately responsible for implementing CEP plans. Through Responsible Care, individual company leadership is accountable to its Leadership Groups, and through the regular independent verifications, to demonstrate its commitment to Responsible Care.

2. Profile of Existing Water Systems

2.1 Water Use Profile

2.1.1 Physical Characteristics

The chemistry industry in Alberta is located primarily in two main geographic areas: the Fort Saskatchewan area, with the North Saskatchewan River as a primary water source, and the Joffre/Prentiss area with the Red Deer River as the primary water source. Individual watersheds are also receiving specific attention by organizations such as the North Saskatchewan Watershed Alliance (NSWA) which has done some excellent work on assessing water quality and quantity aspects of the North Saskatchewan River. Also the 'Water Management Framework' (WMF) for the Industrial Heartland and Capital Region, as part of Alberta Environment and Water's Cumulative Effects Framework has been working for a number of years to address the water quantity and quality issues surrounding the use of the North Saskatchewan River from Devon to Pakan. The WMF is in the process of conducting a major engineering study evaluating industrial water supply and wastewater treatment

currently and future options/alternatives for regional water use and maintaining water quality.

The chemical industry water usage is provided as annual net water usage. Storm water or surface runoff is collected and treated differently by individual companies – some are incorporating it in their site water use whereas others are treating and handling it separately. The monthly water usage variation is not great – fluctuations can arise from ambient temperature changes in relation to cooling towers, but also from a plant turn-around or temporary shut downs. The smaller chemical facilities for the most part utilize municipal water supplies and municipal water treatment facilities and since they constitute a minor portion of the sector water use are not counted in the sector water use summaries. Where facilities are located in proximity to other industrial operations, the CIAC sector companies in some cases provide a utility service to adjacent facilities that may or may not be a chemical sector facility. In other cases the CIAC member facility takes its water supply from another member or non chemical sector member operation. An effort is being made in the reporting to include water usage for the individual facility which is then aggregated into sector totals. The data is aggregated according to the water basin from which it withdraws and to which it returns the water

It should also be noted that the chemical sector industry is a highly regulated industry and as such has been subject to compliance limits and regular reporting requirements over the whole operating life. Consequently it would be desirable to have coordinated water usage reporting between the regulated requirements (approval and license conditions) and the voluntary CEP reporting requirements.

2.1.2 Baseline Water Use

Water use for the chemical industry in Alberta is primarily situated on two river systems, the North Saskatchewan River and the Red Deer River. Current water use is therefore reported separately for each river / drainage basin. The data focus is on water intake (the volume of water diverted from the river) and water consumption (the intake volume less the water volume returned to the river). Storm water is handled in different ways by member companies of the chemical industry and is not being considered in this data.

Total annual North Saskatchewan River water intake and consumption

	Intake (m^3)	Consumption (m^3)
2004	12,433,904	11,039,062
2005	13,076,893	11,319,217
2006	12,181,709	11,391,397
2007	10,898,715	6,897,084
2008	10,032,800	8,414,355
2009	9,388,744	7,896,556

Both Water intake and Consumption on the North Saskatchewan River were reduced significantly over the 2004-2009 period as shown in the following graph. The shut-down of an older part of a chemical production complex in 2006, resulted in a significant decrease in water consumption in 2007. Overall intake and consumption of water from the North Saskatchewan River decreased about 30% from the 2005 levels, and reflect improved efficiency in water usage

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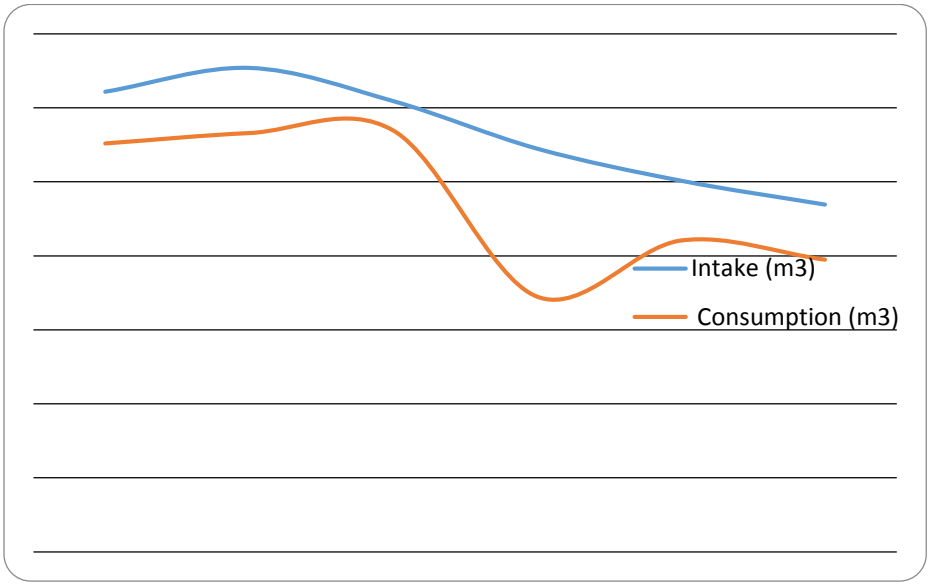
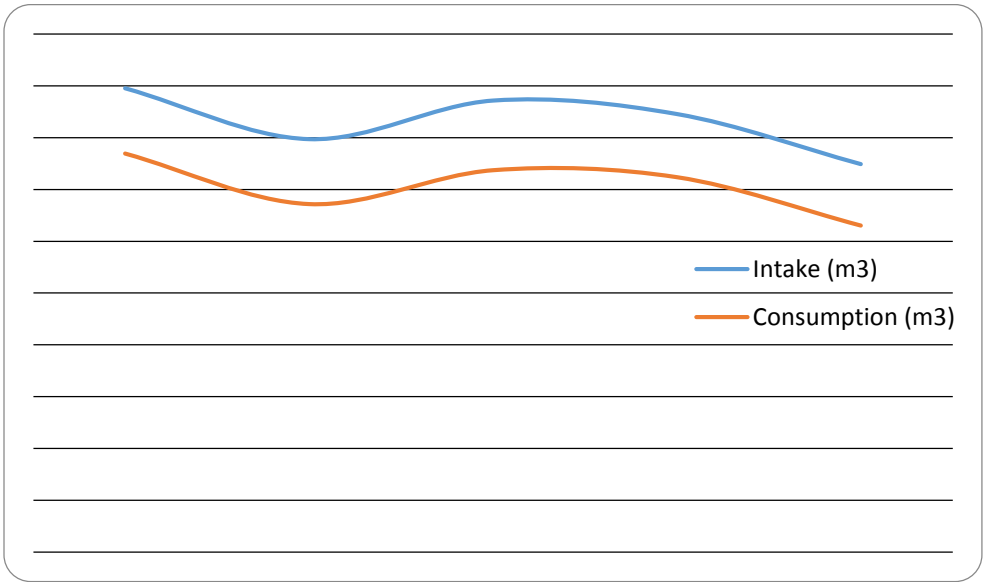
Trend in water usage – North Saskatchewan River



The other concentration of chemical industries in Alberta is in the Joffre and Prentiss area. These facilities take their water from the Red Deer River.

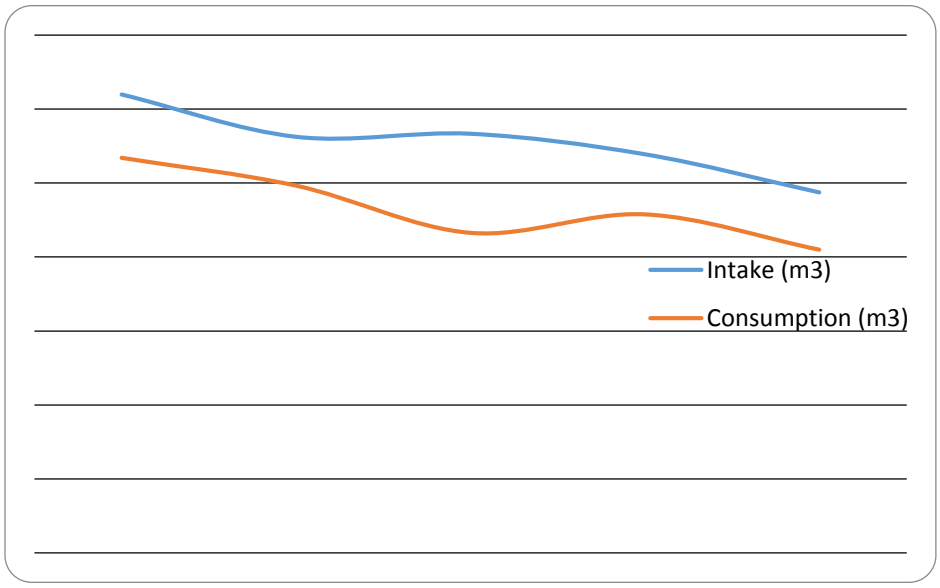
Total RDR	Year	Intake (m^3)	Consumption (m^3)
	2005	17,902,597	15,387,890
	2006	15,938,658	13,437,118
	2007	17,427,725	14,744,774
	2008	16,907,797	14,475,954
	2009	14,975,080	12,609,061

Trend in water usage – Red Deer River



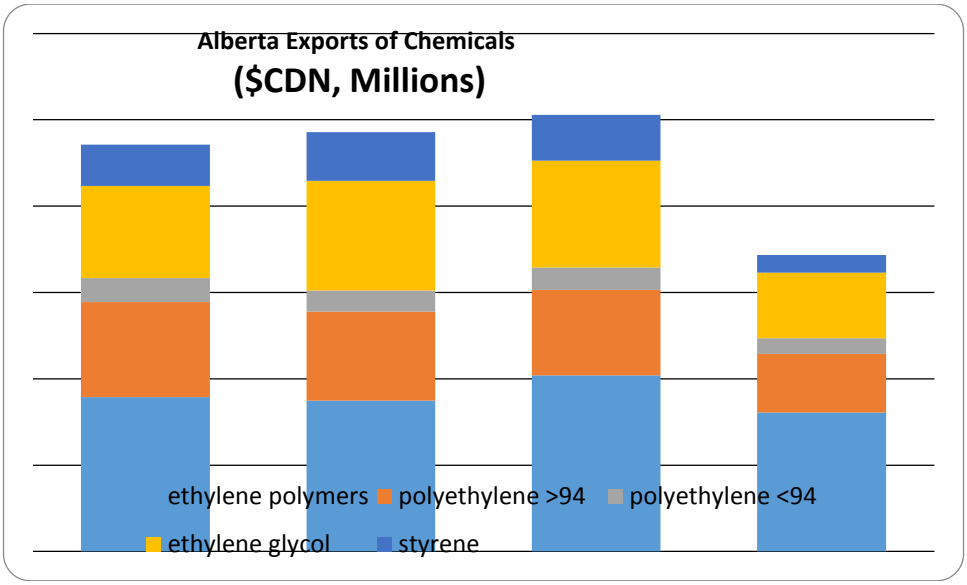
Water usage for the total chemical industry in the period 2005-2009 has been reduced by about 23%. Some of those reductions resulted from the closure of older less efficient components of the facilities.

Trend in Alberta chemical industry water usage 2005-2009



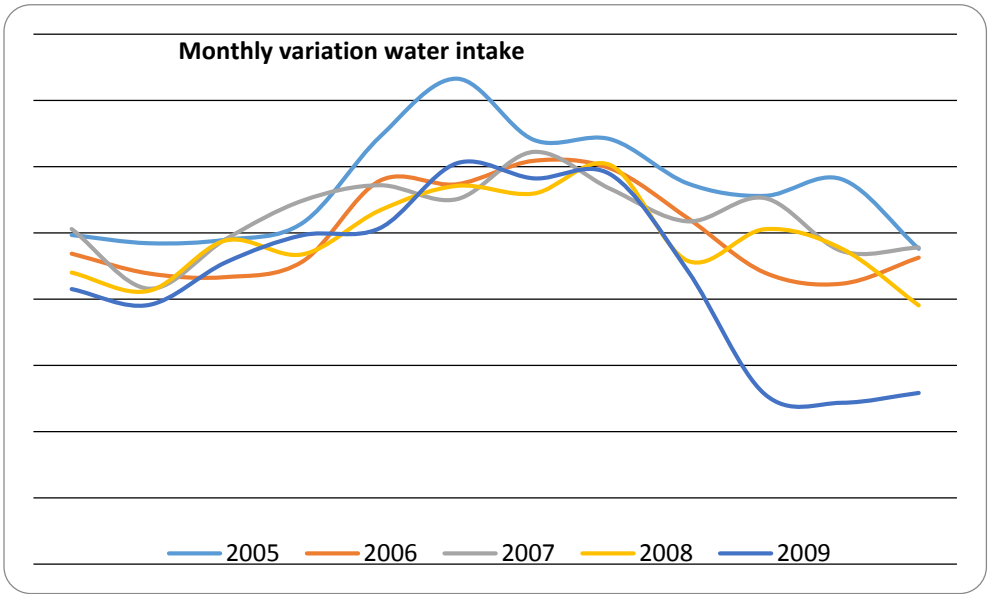
Correlation of water usage with an indicator of productivity

Since the products generated by the chemical industry are quite varied, it is difficult to find a common denominator in the correlation of water use to productivity. One potential performance indicator is the dollar value of Alberta exports of chemicals manufactured by the petrochemical plants. The graph below is taken from data published by the Alberta Government (Alberta International and Intergovernmental Relations) for the years 2006 – 2009. The comparison of yearly trends between export value and industry water usage indicates increased exports relative to 2006 and 2007, while the water usage has decreased over this period. As indicated above, the shut-down of an older facility in the Ft. Saskatchewan area had a significant impact on water usage. The increased consumption in 2008 likely reflects some increased production. A difficulty with using export value however is that the product commodity price varies considerably as was experience in the 2008 economy downturn and is reflected in the significant reduction in export value in 2009. On a longer time basis the export value may provide a more accurate indication of productivity. The 2010 and 2011 data will reflect production increases and may provide a more meaningful correlation to water use.



Monthly volume variation in water usage

Chemical facilities generally operate continuously 24/7 unless a scheduled maintenance or equipment failure disrupts the operation. Water use variation in the chemical industry is relatively low as illustrated in the diagram below which reflects the monthly variation in water intake for several years. Significant variations are reflective more of major plant turnarounds for significant maintenance, where a facility or processing train is shut down. Summer temperatures would account for greater cooling water requirements, however overall it generally falls within a 20% variation. Because of the size and complexity of the facilities, while some parts are shut down, others are still likely to continue operating, thus maintaining some water use requirements



2.1.3 Description of Key Water Uses

Water use in the chemical industry can be in three primary areas: as steam in the process, as cooling water in cooling towers, and as part of the chemical reactions it can be part of the product. Steam and cooling water are key components of chemical manufacture. The raw water, drawn from the river needs to be treated considerably before it can be used in the process. The intake water is treated to remove suspended and/or dissolved solids, minerals and bacteria. High quality water is necessary for use as boiler feed water to maintain the integrity of the boiler and steam system.

The cooling water system is usually an integral part of the process utilities. In order for heated process water to be effectively used again it must be cooled or else additional water must be introduced. Cooling of water is generally achieved in atmospheric cooling towers. Cooling towers consist of cells which drain into a common sump where circulation pumps take the water from the pump suction bay and discharge the water to a common header at the top of the cooling tower. To manage cooling water quality and reduce fouling within the process heat exchangers, a cooling water treatment program is applied.

To maximize resource efficiency, cooling water is circulated seven to eight times before being blown down or evaporated. Blow down is required to prevent the accumulation of solids within the system. Blow down is then generally routed to effluent or wastewater treatment ponds.

To minimize water resource usage some process units are equipped with air coolers, however there are significant difference in cooling efficiency.

Prior to discharge to the river, waste water and storm water surface run off, as well as rain water collected from developed areas, is collected in ponds and treated to remove hydrocarbons, contaminants and suspended solids (sludge).

Another critical use of water is to maintain firewater systems in case of emergency. These are typically circulating systems that are not consumptive unless the water is used for emergency response.

Water can also be a necessary component of a final product such as ethylene glycol, which is made from the reaction of ethylene oxide and water.

Some facilities collect and reuse storm water from their site developed areas to reduce their intake water and wastewater.

2.2 Linkages with other water systems and operating parameters

ERCO Worldwide – Grande Prairie
ERCO Worldwide accesses water from the Wapiti River through a joint partnership with Weyerhaeuser. Through this relationship, Weyerhaeuser provides the ERCO plant with both mill water and potable water. The blow down from the cooling towers is returned to Weyerhaeuser for final treatment and subsequent release back to the Wapiti River.

Dow Chemical Canada ULC – Fort Saskatchewan
Dow provides water service to other industries, including MEGlobal Canada, Praxair and Keyera, within the Fort Saskatchewan area using its water intake. Each company has its own water allocation under the Water Act, and their approvals note the water access "…through the works of Dow Chemical Canada Inc.". This service arrangement allows other users to access water from the North Saskatchewan River according to their approved water allocation, while reducing the number of water intake structures in the River.

MEGlobal Canada Inc. – Prentiss
MEGlobal provides water service to Dow on at the Prentiss site. This service arrangement allows Dow to access water from the Red Deer River through MEGlobal works.

2.3 Review of Current Policies and Programs

All aspects of chemistry facility operations, including water quantity, water quality, air quality, and soil and groundwater impact have been regulated extensively since the Alberta Clean Air and Clean Water legislation came into force in 1971, and even before that under Environmental Health legislation. Under Responsible Care, member companies not only commit to meet all regulatory requirements, but to work on continual improvement to reduce the impact on the environment, as has been demonstrated by the Reducing Emissions Report.

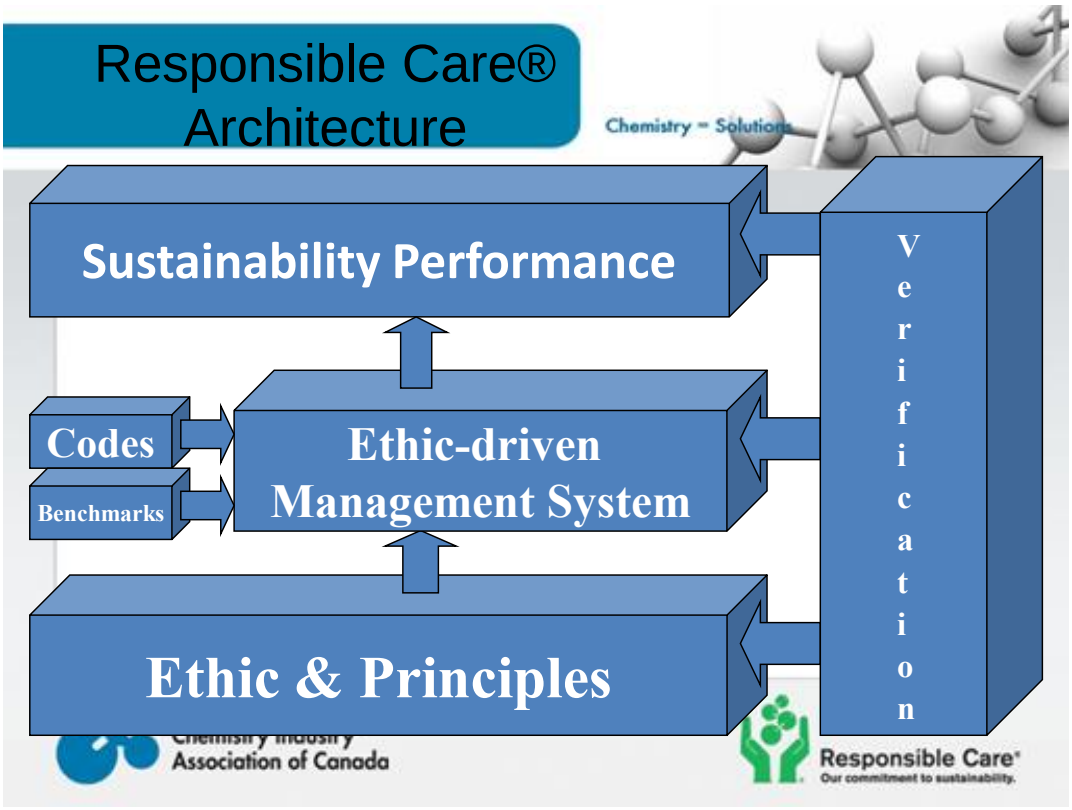
Each of the CIAC member facilities is licensed and has an approval under the Alberta Environmental Protection and Enhancement Act (EPEA) and/or the Alberta Water Act. The approvals stipulate operating parameters as well as monitoring and reporting requirements. CIAC member companies are committed to not only comply but through continuous improvement consider the environmental impact of the operations.

The Responsible Care® initiative is the chemistry industry's most outstanding achievement. It was established in 1985 to address public concerns about the manufacture, distribution and use of chemicals following the chemical spill in Bhopal, India in December 1984. Since its inception, Responsible Care® has guided the chemistry industry in Canada and has been adopted all around the world; In 2008 Responsible Care® was reviewed to add sustainability as its driving force.

Responsible Care® is the chemistry industry's commitment to sustainability – the betterment of society, the environment and the economy. Its ethic and principles compel companies to

innovate for safer and more environmentally friendly products and processes, and to work cooperatively to identify and eliminate harm throughout the entire life cycle of their products. Responsible Care® is our commitment to continuous improvement of all aspects of the chemistry industry's environmental health and safety performance and to ensuring openness about its activities and achievements.

Responsible Care® covers all aspects of a company's business, including environmental protection, resource conservation, occupational health and safety, process safety, research and development, transportation, product stewardship, purchasing, security and social responsibility. It requires engagement with plant-site neighbours, communities along transportation corridors, critics and advocates as well as with governments at all levels, to advance laws and regulations in support of sustainability.



As an ethic Responsible Care® distinguishes itself from other environmental management systems, in that it is a total corporate shift in the interaction with regulators and the public as shown in the ethic comparison table in the appendix. It is reflected in responsible actions throughout the organization and a concern for maintaining and enhancing credibility with the public and with regulators, even while pursuing competitiveness in the global economy. The third party independent verification process is important to assure the companies and the public that the ethic and practices of Responsible Care® are indeed in place and driving continuous improvement. Every three years companies are verified by teams of industry experts, public advocates and local citizens, who write a consensus report summarizing the verification process and players, opportunities fro improvement, findings requiring corrective

action and successful practices. Once the team has successfully completed their work (with repeat visits as necessary) the company is presented with a verification certificate. Verification reports are made available to their local communities and other interested parties by the verified company and through the CIAC public website at www.ccpa.ca

2.3.1 Related Policies, Programs and Plans

A number of related provincial policies, programs and plans have the potential to directly affect the chemical industry, and have been areas where CIAC or its member companies have been involved in developing provincial and federal policies.

Alberta Water Council
In conjunction with CPPI, the chemistry industry has been represented at the Alberta Water Council since its inception. CIAC has supported the objectives of the Water for Life initiative

Clean Air Strategic Alliance

Air and Water Management Frameworks

2.3.2 Related Legislated Conditions or Clauses

Key provincial legislation, Acts and Regulations that apply to the chemical industry include the following:

- Alberta Environmental Protection & Enhancement Act (1993)
- Water Act
- Activities Designation Regulation
- Approvals and Registrations Procedure Regulation
- Release Reporting Regulation
- Substance Release Regulation
- Waste Control Regulation
- Wastewater and Storm Drainage Regulation
- Water (Ministerial) Regulation

Additionally federal legislation such as the Canadian Environment Protection Act and the Statistics Canada Industrial Water Survey applies to the chemistry industry.

Guidelines also provide clarity with regard to specific parameters or operations, and become legally enforceable when linked to an industrial approval. Some of the relevant guidelines include:

- Surface Water Quality Guidelines for use in Alberta
- Alberta Ambient Air Quality Objectives
- Guide to Content of Industrial Approval Applications
- Water and Wastewater Operators Certification Guidelines

2.4 Sector History of CEP

Like energy conservation, water use efficiency has been an integral component of plant operations and continuous improvement under Responsible Care®. Significant efficiency improvements have occurred over the years with major capital expenditures, such as in the construction of a new ethylene cracker or process train. In general the newer technology has greater efficiency incorporated with significant associated environmental benefits. Due to the high capital costs of these major process capacity step changes, the chemistry industry has seen these occur only every 5-10 years in Alberta. Smaller efficiency initiatives are incorporated on an ongoing basis, through regular maintenance and process control improvements.

Although the focus of 'Reducing Emissions' has been more on atmospheric emissions and especially the emission reduction of toxic substances, the discharge or emission of metals to water has been recognized in monitoring and reporting by CIAC member companies as early as 1992, and has shown very significant reductions in these emissions. (See p.21, Reducing Emissions 19 Report at www.ccpa.ca)

2.4.1 Examples of individual company CEP developments:

Dow Chemical Canada ULC, Ft. Saskatchewan exemplified the chemical sector's focus on water efficiency at the Fort Saskatchewan site which was built incorporating storm water recycling to reduce fresh water intake needs. When the ethylene cracker was constructed, it was designed to have no discharge back to the North Saskatchewan River. This portion of the Dow Fort Saskatchewan facility recovers and treats its wastewater for reuse through a dedicated water treatment facility.

Dow reuses storm water collected from portions of the Fort site. The Dow Hydrocarbons plant is completely off the river, with no discharge back to the river and recycling all its wastewater internally. Since 2006 when the Chlor-Alkali plant shut down, Dow water usage has dropped. Dow uses water for both process and cooling water, as does MEGlobal

Dow and MEGlobal reuse storm water collected from portions of the site. Prentiss uses water for both process and cooling water. A 31% decrease in the LP-7 cooling tower blow down (Wastewater to treatment) as a result of decreased make-up water from the Process Water Recovery System to the LP-7 Cooling Tower.

NOVA Chemicals, Joffre installed a Phosphate Removal System (PRS) during site expansion in 2000 in order to reduce phosphorus concentrations in effluent being discharged to the Red Deer River. This system treats water for both the NOVA Chemicals and INEOS plants within the Joffre site facility.

2.4.2 Other initiatives consistent with Alberta's Water for Life strategy goals

CIAC supports the three goals of the Water for Life strategy: safe, secure drinking water supply, healthy aquatic ecosystems, and reliable, quality water supplies for a sustainable economy. This support is demonstrated in the many ways member companies support the communities they operate in and where many of the workers live in. Safe and secure drinking water is not only a priority on the plant site, but in the surrounding communities as well. Companies have demonstrated their commitment to maintaining a healthy aquatic ecosystem in local projects as well, as shown in these two examples:

(i) MEGlobal supports of the Ellis Bird Farm, located across the road from the Prentiss petrochemical facility in the County of Lacombe. The Ellis Bird Farm operates and maintains a bird conservation program targeted specifically to encourage the nesting and propagation of Mountain Bluebirds and Tree Swallows. Ellis Bird Farm Ltd is now a non-profit charitable company with MEGlobal being the major funding partner.

(ii) Dow Chemical Canada LLP has demonstrated environmental stewardship with its Ft. Saskatchewan site Wildlife Greenbelt project. This project was initiated in 1992 to limit the impact of the new Dow Hydrocarbon Product plant on existing wildlife and to encourage the movement of wildlife throughout this area. The greenbelt contains ponds, a wetlands area, wildlife travel corridors, and observation deck, and an air monitoring trailer where visitors can see the air they breathe being monitored for quality.

3.0 Water Supply and Demand Considerations

3.1 Water Demand Forecasting

The opportunities for petrochemical industry growth are related to the availability of feedstock and that is changing with the potential for increased shale gas and liquids production. Consequently there may be opportunities for increased production capacity and therefore some increased water usage for the chemical sector. It is anticipated that any increased production will be more efficient in water use per unit increase and result in higher productivity. The amount of increased production and water demand is difficult to estimate at this time, however, the chemical industry with the significant capital investments are here for the long term and water use for our existing industries will continue to be an important resource for the foreseeable future. In general it is anticipated that chemical industry water use will remain relatively stable with some minor reductions, as efficiency initiatives are implemented.

3.2 Water Supply Considerations

Reliable water supply is important, and therefore the chemistry industry is actively participating in regional and sub-regional water management

framework discussions that address current and future water use management, both on a water quantity and water quality basis.

4. Overview of Opportunities for CEP

As part of the Responsible Care® commitment and the CIAC endorsement of sustainability, opportunities to reduce energy and water consumption are an integral part of facility operations. Opportunities are reflected in conservation, efficiency and in productivity. Reducing the amount of water used in the process means reduced treatment of intake water and along with efforts to enhance the efficiency of water use make sense not only from an environmental perspective but also as a cost efficiency benefit. Productivity increases as efforts to debottleneck processes increases the amount of product, usually at smaller incremental water use or processing costs. Therefore the implementation of CEP opportunities has a positive impact on all aspects of sustainability. Emission controls are tracked annually in the 'Reducing Emissions' reports which is a public document.

CEP opportunities for the chemical industry are focused on process control and quality maintenance. As part of continuous improvement small incremental measures will be implemented to reduce unnecessary wastage from process leaks and to enhance water use efficiency. Major water use efficiency enhancements can only come from major capital investments or where a less efficient process train is shut down.

The larger chemical producing facilities are large, integrated and complex operations, not dissimilar from refining operations and therefore the CIAC CEP opportunities do mirror a lot of the CPPI identified CEP opportunities.

4.1 Identification of all CEP Opportunities

Manage cooling water to minimize fresh water use ➢ *Conservation / efficiency* ➢ *Cooling water is managed to increase the number of cycles which minimizes fresh water use*
Consolidate wastewater streams for treatment at offsite regional facilities and reuse of the treated wastewater ➢ *Conservation / efficiency*

➢ *Examples are Phosphate Removal System at NOVA Chemicals and Secondary Wastewater Treatment facility for the multi facility complex* ➢ *Part of the option consideration at the Industrial Heartland and Capital Region Water Management Framework*
By product or wastewater synergies where one companies wastewater can be used at another facility ➢ *Conservation / efficiency* ➢ *Example – NOVA Chemicals operates the wastewater treatment facility at the Joffre site which provides synergies with the INEOS facility* ➢ *Part of the option consideration at the Industrial Heartland and Capital Region Water Management Framework*
Discharge of sanitary wastewater to common municipal facilities ➢ *Efficiency* ➢ *NOVA Chemicals operates a sanitary wastewater treatment facility for the Joffre site* ➢ *Part of the option consideration at the Industrial Heartland and Capital Region Water Management Framework*
Storm water recycle ➢ *Efficiency* ➢ *System is in place to capture and use storm water*
Segregation of storm water and reuse as cooling tower makeup ➢ *Conservation* ➢ *Separate storm water and effluent ponds are used to segregate these streams at Joffre*
Recycle of boiler blow down ➢ *Efficiency* ➢ *Boiler condensate and blow down are recycled through the clarifiers for reuse*
Optimization of boiler feed water treatment to minimize resultant wastewater ➢ *Efficiency* ➢ *Demineralization media selection require reduced water use which optimizes the wastewater from the boiler feed water system*
Investigate treatment, reuse, and recycling of wastewater streams as fresh water make up ➢ *Conservation / efficiency*

➢ *This option has been investigated at some sites and not deemed feasible based on the changes required to make this a viable alternative* ➢ *Part of the option consideration at the Industrial Heartland and Capital Region Water Management Framework*
Debottleneck the facilities to increase the volume/weight of product significantly without a significant increase in water use ➢ *Productivity* ➢ *As feedstock availability increases, facilities have an opportunity to incrementally increase production while minimizing the water use increase* ➢ *Major capital expenditures for upgrades provide an even greater opportunity to replace some production units with more efficient equipment and therefore have significant productivity gains*

4.2 Analysis of CEP opportunities

Some of the above CEP opportunities are already in place and can be optimized in some facilities or implemented in others. In the Industrial Heartland Capital Region, the concentration of facilities in reasonable proximity provides greater opportunity to explore innovative options such as is discussed in the Water Management Framework considerations. Some of the options however can be very expensive to implement and involve significant common infrastructure investments that are currently not justifiable. Responsible Care commits CIAC member companies to continuous improvement and as the major CIAC water using companies work on the above CEP opportunities, other opportunities will be evaluated and added in future years.

4.3 Selected / Recommended CEP Opportunities and Targets

As indicated in the points under the CEP opportunities, they will not be implemented universally at all of the facilities, as some work better than others, and will be more effective. Collectively though, the chemistry industry in Alberta and nationally has demonstrated a commitment to sustainability through reducing emissions, resource conservation, improved efficiency and at the same time increasing productivity.

5. CEP Plan Implementation and Monitoring

5.1 Implementation Schedule

CIAC member companies as part of the commitment to Responsible Care® are in the process of implementing annual water use reporting on a national basis. From the data collected, CIAC will also be able to track annual water intake and consumption on a provincial basis for the chemical industry (CIAC members companies) and therefore monitor and report on progress made to reduce water usage.

CIAC will review progress on the implementation of CEP opportunities through its Alberta Environmental Quality Committee annually at the main meeting each spring, and will endeavor to document any significant specific company CEP initiatives, either on the public website or in public documents. As well individual facility licenses or approvals for water use and operation, water withdrawals and discharge are reported to Alberta Environment and Water on an ongoing basis.

5.2 Integration with other Plans

CIAC and its member companies will continue to participate in the development of the regional management frameworks that the industry facilities are located. The key related management framework currently is the Water Management Framework for the Industrial Heartland and Capital Region. This WMF focuses on the Devon to Pakan reach of the North Saskatchewan River and as such includes the CIAC member company water intakes in the Ft. Saskatchewan area. Both water quantity and water quality are considered in this WMF with emphasis not only on current but also on future cumulative impacts on the North Saskatchewan River. The WMF for the Industrial Heartland and Capital Region has been actively worked on for the past two years and is fairly well developed at this stage.

The other main region of specific interest to CIAC and its member companies is the Red Deer River reach serving as the water intake for the Joffre and Prentiss area facilities. The WMF for this region is not well developed but CIAC and member companies will get engaged in its development as it proceeds further.

5.3 Monitoring and Reporting

CIAC, as part of the accountability and performance measurement requires all member companies to report on an annual basis key emission parameters, above and beyond the reporting requirements under the federal NPRI reporting requirements and the provincial approval reporting. The data from these reports is compiled and published in the annual Reporting Emissions report and made available on the public website.

6. Participation and Accountability

Member companies of the Chemistry Industry Association of Canada, under Responsible Care®, maintain liaison with the community through the Community Advisory Panels (CAPs). The CIAC CEP Plan will be shared for review and comments by the North Saskatchewan Watershed Alliance (NSWA), and the Red Deer River Watershed Alliance.

7. Summary and Recommendations

This report documents water use for the chemistry sector (member companies of CIAC) in Alberta. The Chemistry Industry Association of Canada member companies, with the Responsible Care® commitment, have been implementing measures to reduce the impact of their operations on the environment. In order to demonstrate that environmental responsibility is being taken serious and to develop credibility, the annual publishing of 'Reducing Emissions' for almost 20 years has documented the collective efforts of the chemical industry and the results achieved. Although individual companies have been implementing measure to reduce water consumption, improve water quality effluent, and enhance efficiency while increasing productivity, formalizing the effort and documentation through the CEP plan will also provide a better measure of performance achieved.

This CIAC CEP Plan represents the water use for the chemistry sector in Alberta and is submitted as part of the Chemical and Petrochemical sector under the AWC guidelines. It should also be recognized when the chemistry sector refers to petrochemical facilities, these are primarily the facilities that crack ethane and produce ethylene and further derivatives in the value chain. In contrast the CPPI petrochemical reference is primarily to downstream petroleum refining.

Similar to the CPPI downstream petroleum refining sector the chemistry industry is a relatively small water user compared to the other six sectors identified in the AWC guidelines. As with other large industrial facilities, Alberta Environment and Sustainable Resource Development (AESRD) through the Environmental Protection and Enhancement Act (EPEA) and the Water Act regulate the operations through comprehensive approvals that provide emission and discharge limits and specify maximum contaminant in the emission or discharge, to protect the environment including the receiving aquatic system. CIAC member companies under Responsible Care not only strive to meet those environmental protection limits, but work to keep the actual emissions and discharges well below those limits.

CIAC membership consists of the larger integrated complexes such as in Joffre, Prentiss or Ft. Saskatchewan, but also of a number of mid-sized or smaller operations in Alberta. For this report, only the larger facilities were considered as they represent well over 90% of the water consumption of the industry. The smaller facilities depend primarily on municipal water supplies and discharge their effluent to municipal facilities. Overall the chemical industry is a relatively small water user, compared to the other sectors that have compiled their CEP plan, but the existing, relatively large capital investments mean that the facilities are here for the long term and depend on available water use throughout that

period. At the same time the chemical industry fully recognizes the importance of preserving the sustainability of our natural resources.

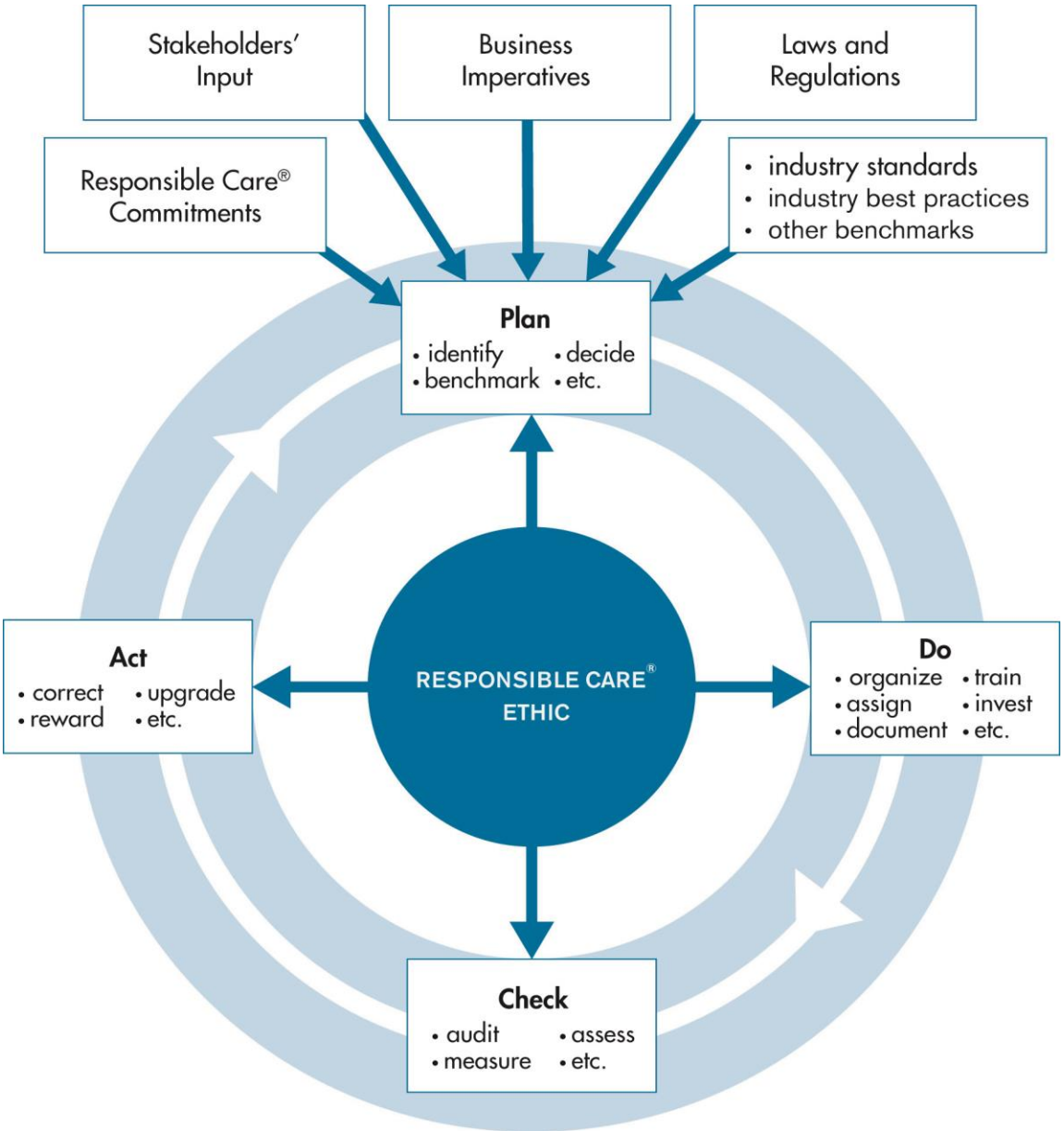
Two aspects to implementing the CIAC CEP Plan are reflected in the scale of the facilities and the significant capital investments involved. A vibrant and growing industry provides the best opportunity for implementing new control and efficiency technology. The most significant improvements in water use in the chemistry industry as discussed in this plan will occur with major capital investments related to stock turnover or expansion. This allows older, less efficient equipment to be taken out of service and replaced with current technology resulting in greater efficiency and productivity. On more of an ongoing basis, smaller efforts will continue to implement CEP opportunities, and while it is difficult to set targets, CIAC has demonstrated that cumulatively smaller efficiency improvements can add up to significant year over year improvements and that is what the chemistry sector will work toward in the implementation of the CIAC CEP plan.

APPENDIXES – GENERAL INDUSTRY INFORMATION – see also www.canadianchemistry.ca

Alberta CIAC member companies:

- Ashland Canada Corp.
- BASF Canada
- Canexus Chemicals Canada LP
- Dow Chemical Canada ULC
- ERCO Worldwide
- Evonik Degussa Canada Inc. (Gibbons)
- Imperial Oil, Products & Chemicals Division
- INEOS Canada Partnership
- MARSULEX Inc.
- MEGlobal Canada Inc.
- Methanex Corp.
- Newalta Corporation
- Nalco Canada Co.
- National Silicates
- NOVA Chemicals Corporation
- Shell Chemicals Canada

Managing for Responsible Care



New Principles for Sustainability

We dedicate ourselves, our technology and our business practices to **sustainability** - the **betterment** of society, the environment and **the economy**. The principles of Responsible Care are key to our **business success**, and compel us to:

- work for the **improvement** of people's lives and the environment, while striving to do **no harm**;
- be accountable and responsive to the public, especially our local communities, who have the right to understand the risks and **benefits** of what we do;
- take **preventative action** to protect health and the environment
- **innovate** for **safer products and processes** that **conserve** resources and provide **enhanced value**;
- engage with our **business partners** to ensure the stewardship and **security** of our products, services and raw materials throughout their life-cycles;

Attributes of our Ethic

The "Other Ethic"

X meet the law

X resist new laws

X keep a low profile

X product liability - customers' problem

X downplay public concerns

X do less "bad"

X manage risks

X chemicals innocent 'til proven guilty

X compliance

X hazard information to who needs it

X every company for themselves

X ignore or fight activists

X "social responsibility" not our role

The Responsible Care Ethic

✓ do right thing (exceed laws)

✓ work for strong regulations

✓ be seen to do right (or wrong) thing

✓ life cycle stewardship – value-chain

✓ seek & address public concerns

✓ improve people's lives & env. & do no harm

✓ inherent safety, "green" chemistry and eng.

✓ preventative action (precautionary approach)

✓ continual improvement & innovation

✓ public, employees right to understand

✓ mutual aid & peer pressure

✓ seek activists' input

✓ understand & meet social responsibilities

How the Ethic is Sustained

✓ Public CEO commitment, up front & annually

✓ Code implementation tracking

✓ Networking - CEO & technical level

✓ National Advisory Panel

✓ Performance reporting

✓ Public/peer verification

Chemistry Industry Association of Canada | Association canadienne de l'industrie de la chimie

Responsible Care® Our commitment to sustainability. Gestion responsable™

31