Water Conservation, Efficiency, and Productivity Sector Plan Implementation Update

2023

September 2025

About the Alberta Water Council

Initially established in 2004 to serve an advisory function to government, the Alberta Water Council (AWC) evolved and incorporated as a not-for-profit society in 2007. The AWC is a collaborative partnership that consists of members from governments, industry, Indigenous groups, and non-government organizations. Its primary task continues to be to monitor and steward the implementation of Alberta's *Water for Life* strategy and to champion the achievement of the strategy's goals. It also advises the Alberta government, industry, governments, non-government organizations, and Albertans on matters pertaining to stewarding the outcomes of the *Water for Life* strategy and on effective water resources management policies, practices, and tools. The advice of the AWC generally has the consensus support of its members and is consistently considered when informing water resources management in Alberta. However, the Government of Alberta remains accountable for the implementation of the *Water for Life* strategy and continues to administer water and watershed management activities throughout the province.

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Foreword

In 2003, the Government of Alberta (GoA) released the *Water for Life* strategy to guide the province's water management. The strategy included a target to improve the overall efficiency and productivity of water use in Alberta by 30% from 2005 levels by 2015. The Alberta Water Council (AWC) was identified as the group best-positioned to support the work of the major water-using sectors to contribute to this goal. What followed was the voluntary commitment of these sectors to improve water conservation, efficiency, and productivity. The continued work of these sectors in this endeavour are featured in this report as it is crucial to recognize the collective efforts made by these major water-using sectors. However, due to recent extreme drought conditions in Alberta and the potential for similar situations to occur more frequently in the future, it is recognized that water conservation is not just a sectoral concern, but a shared priority for all AWC members. In addition to highlighting sectors' collective efforts in water conservation, this report serves to underscore the vital importance of continued responsible water management to ensure water security, now and in the future.

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Figures and Tables

Acronyms

ABmunis	Alberta Municipalities
AER	Alberta Energy Regulator
AFPA	Alberta Forest Products Association
AIDA	Alberta Irrigation Districts Associations
ANC	Alberta Newsprint Company
AUMA	Alberta Urban Municipalities Association
AUPRF	Alberta Upstream Petroleum Research Fund
AWC	Alberta Water Council
BAU	Business-as-usual
BOE	Barrel of oil equivalent
CAPP	Canadian Association of Petroleum Producers
CCUS	Carbon capture, use, and storage
CEP	Water conservation, efficiency, and productivity
CFA	Canadian Fuels Association
CIAC	Chemistry Industry Association of Canada
CO_2	Carbon dioxide
EPA	(Alberta) Environment and Protected Areas
EPEA	*Environmental Protection and Enhancement Act*
GHG	Greenhouse gas
GoA	Government of Alberta
IP	International Paper
NO_x	Nitrogen oxides
PRIA	Plastics Research in Action
SWQMF	Surface Water Quality Management Framework
WPAC	Watershed Planning and Advisory Council
WURS	Water Use Reporting System

Executive Summary

The *Water for Life* strategy established a target to improve the overall efficiency and productivity of water use in Alberta by 30% from 2005 levels by 2015. Since 2006, three Alberta Water Council (AWC) project teams have supported Alberta's seven major water-using sectors in voluntarily developing and implementing sector-level water conservation, efficiency, and productivity (CEP) plans to contribute to the target. Then, a fourth team was struck in October 2015 to evaluate and report on the success of implemented CEP activities. The team evaluated improvements as measured against the sectors' criteria for success; contributions to the three goals of the *Water for Life* strategy, including the specific aspirational target of improving water use efficiency and productivity by 30% from 2005 levels by 2015; and other desired CEP outcomes. The team's final report was approved by the AWC in March 2017 and released in October 2017. The evaluation demonstrated that water use efficiency and productivity improved by 32% over the initial reporting period (roughly 2005–2015), exceeding the 30% target established by *Water for Life*.

In the final report *Looking Back: Evaluating Sector Improvements in Water Conservation, Efficiency and Productivity*, Recommendation 1 calls for "Major water-using sectors [to] collaborate with the Government of Alberta and other partners including the Alberta Water Council to continue reporting CEP trends and progress. Reporting will occur through the Alberta Water Council at five-year intervals using the performance indicators and baseline data in Appendix C (ongoing)."

The AWC's seven major water-using sectors provided an update on their CEP activities and achievements in the first five years following the initial reporting period at a dedicated session in October 2023. During this recent five-year reporting period (roughly 2017–2022, depending on the sector), several sectors maintained the progress of the initial reporting period or demonstrated improvements. Others saw a decline in their efficiency and productivity, though often demonstrated increased production during the current five-year reporting period and attributed the decline to sector-specific circumstances which are detailed in section 2.

A direct comparison to the achievement of the initial 32% improvement from the initial reporting period of 2005–2015 compared to business-as-usual (BAU) was not possible. Some sources of data were unavailable, policies that affect water use by the sectors have changed since 2015, and other external factors affecting water use could not be captured in a BAU scenario. Several sectors also noted in their 2017 implementation update that many had achieved near the maximum level of CEP possible at the time, and any further gains were likely to be minimal and at a high capital cost. However, some noted that continued research and development could potentially lead to further increases in CEP.

1. Introduction

In 2003, the Government of Alberta (GoA) formally recognized the fundamental role and importance of water by adopting the *Water for Life* strategy.[1] *Water for Life* is Alberta's overarching strategy for managing the province's water resources. The strategy emphasizes the dependence of communities and our province's economic well-being on clean, sustainable water supplies and healthy aquatic ecosystems. It highlights the importance of working collaboratively with partners to advance the strategy's goals and key directions.

The *Water for Life* strategy was renewed in 2008[2], followed by the *Water for Life* action plan in 2009.[3] The renewed strategy maintained the focus on the original goals of achieving:

- safe, secure drinking water
- healthy aquatic ecosystems
- reliable, quality water supplies for a sustainable economy

Three key directions that support achieving the goals were also reiterated:

- knowledge and research
- partnerships
- water conservation

The *Water for Life* strategy identified the development of "water conservation and productivity plans for all water-using sectors" as a key medium-term action, to be followed by long-term action to "establish an ongoing monitoring program to ensure all sectors are achieving water conservation and productivity objectives."

Since the last reporting period:

- Alberta's population has grown by approximately 600,000, to an estimated 4.8 million people (as of January 1, 2024), up from 4.2 million in 2017 (Figure 1).[4]
- By 2051, Alberta is projected to have a population of 7.1 million people.[5]
- Alberta's Total Provincial Gross Domestic Product (GDP) was $336.3 billion in 2023, a 5% increase from $319.2 billion in 2017.[6]

1 https://open.alberta.ca/dataset/77189444-7456-47f7-944c-085272b1a79c/resource/17c41dc3-1692-4cf9-b931-2892c57a62b1/download/2003-water-life-albertas-strategy-sustainability-november-2003.pdf

2 https://open.alberta.ca/dataset/16e373f7-35c6-438c-8028-b9ab7e3e2fee/resource/bd7930bf-da3b-449a-8630-ef0b11dde99e/download/waterforlife-renewal-nov2008.pdf

3 https://open.alberta.ca/dataset/2a91e8c6-ea9a-44c4-a76d-cd35a9a296f7/resource/49531a5a-e16c-4250-a9a4-0028fa500854/download/2009-waterforlife-actionplan-nov2009.pdf

4 https://www.alberta.ca/population-statistics

5 https://www.alberta.ca/current-provincial-population-projections

6 https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610040202

- In 2023 and 2024, areas of the province experienced drought conditions, and multiple management areas were impacted by water shortage.
- Since 2020, there has been an average of 20 agricultural disasters declared by municipalities or counties in the province every year, with four being the low (declared in 2022) and 43 being the high (declared in 2021).

The escalating demands on water resources resulting from population and economic growth and the compounding impacts of climate change underscore the importance of having robust water CEP plans in place. As the province's population and economy expands and extreme climate events like drought and wildfires increase, the strain on available water supplies is expected to intensify. As such, these plans serve as essential frameworks that contribute to achieving the goals of *Water for Life.*

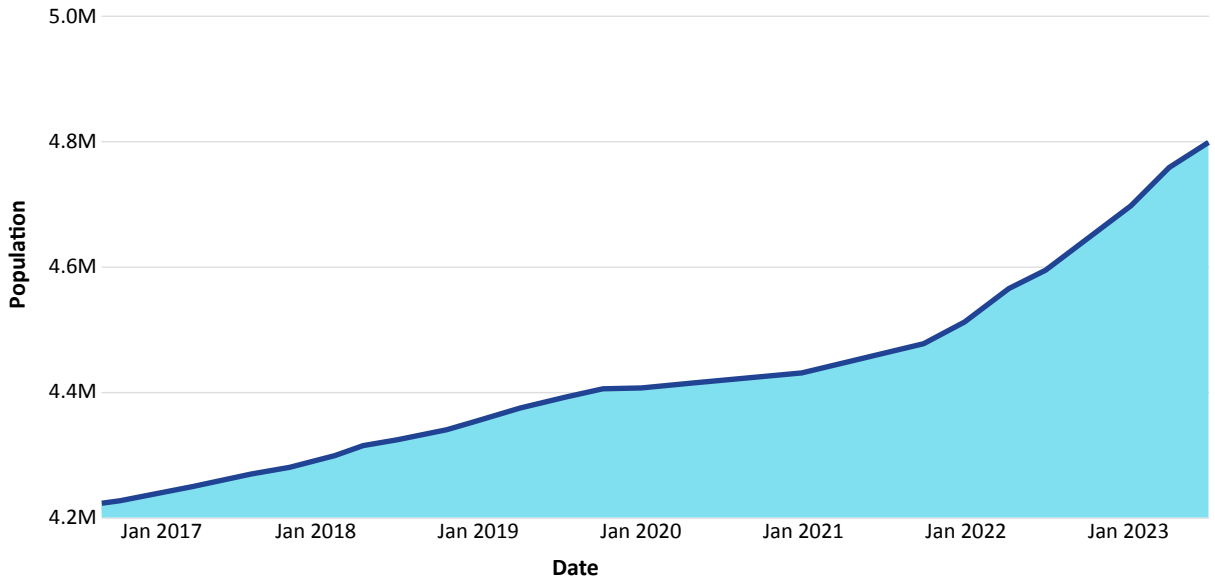

Figure 1. Population growth in Alberta over the latest CEP reporting period

1.1 Alberta Water Council Involvement in Water Conservation, Efficiency, and Productivity

The AWC's CEP initiative originates from the *Water for Life* strategy which set the target of a 30% improvement in efficiency and productivity of water use in Alberta from 2005 levels by 2015. This target was reaffirmed with the renewal of *Water for Life* in 2008. To support achieving the 30% target, four AWC project teams have supported CEP work over a period of ten years:

- The first team established guiding principles and definitions of CEP.
- The second team developed a framework to support the development of plans.
- The third team supported the seven major water-using sectors in developing their respective CEP plans.

- The fourth team reported on and evaluated the success of implemented CEP activities since the development of the plans.

Throughout this report, unless otherwise specified, the terms "CEP plan" and "plan" are used to refer to sector-level plans, which encompass an entire sector as defined by the AWC.[7] The development of these plans were led by the AWC's CEP sector representatives. Several facility-level or municipal-level CEP plans have been developed but are not specifically covered in this report.

1.1.1 Phase 1 – Water Conservation, Efficiency, and Productivity Definitions

In March 2006, the Water Conservation, Efficiency, and Productivity Definition Project Team was tasked with providing clear, understandable definitions, principles, and expectations for the terms "conservation", "efficiency", and "productivity".[8] The following definitions were established:

- Water conservation:
  - Any beneficial reduction in water use, loss, or waste.
  - Water management practices that improve the use of water resources to benefit people or the environment.
- Water efficiency:
  - Accomplishment of a function, task, process, or result with the minimal amount of water feasible.
  - An indicator of the relationship between the amount of water needed for a particular purpose and the quantity of water used or diverted.
- Water productivity:
  - The amount of water that is required to produce a unit of any good, service, or societal value.

The team also accepted the following as desired outcomes of improvements in CEP:

- demand for water is reduced
- water use productivity is increased
- resources are conserved to maintain healthy aquatic ecosystems
- water quality is maintained or enhanced

7 https://www.awchome.ca/uploads/source/AWC_Process_Guidelines_2021_Final.pdf

8 https://www.awchome.ca/_projectdocs/?file=1915519d80abe0b3

Finally, eight principles were adopted to guide improvements in CEP:

- Fresh water is a finite and vulnerable resources, essential to sustain life, economic development, and the environment.
- Water has an economic value in all its competing uses.
- Water has non-monetary values that enhance the quality of life.
- Sectors are accountable for what they control.
- Sectors have different opportunities for making progress in CEP and are not necessarily comparable against other sectors.
- Sector plans will make every reasonable effort to protect and enhance aquatic ecosystems and meet ecosystem objectives.
- All stakeholders will work collaboratively, resolve differences through consensus processes, and support best management practices.
- The GoA will assure that goals for water conservation, efficiency, and productivity are achieved.

1.1.2 Phase 2 – Water Conservation, Efficiency, and Productivity Sector Planning

The second project team, formed in 2007, built on the work completed by the first team and identified seven major water-using sectors in Alberta to develop plans to ensure maximum benefit.[9] By reviewing data related to water use by sector, the following sectors were determined to be priorities for completing sector CEP plans:

- Chemical and Petrochemical
- Forestry
- Irrigation
- Mining/Oil Sands
- Municipal
- Oil and Gas
- Power Generation

A framework was also developed to guide these sectors in developing their plans and consisted of the following components:

- an annotated table of contents for sectors to follow when developing their plans
- an evaluated list of tools that may be used to address issues of participation and accountability
- benchmark water use data and best management practices for water conservation, efficiency, and productivity by sector

This team also made 21 recommendations to support CEP improvements.

9 https://www.awchome.ca/_projectdocs/?file=e05b420d35fda282

1.1.3 Phase 3 – Sector Planning for Water Conservation, Efficiency, and Productivity

Beginning in 2010, the third team served as a forum to reduce challenges in developing and implementing sector CEP plans through sharing of ideas, knowledge, opportunities, and experiences.[10] The team was also responsible for evaluating and determining the need for enhancements to the CEP framework developed by the second CEP team. The project resulted in a report that identified gaps and potential improvements to the framework and process used to develop CEP plans; highlights of individual sector CEP plans; and recommendations aimed at ensuring progress on CEP sector plan goals as well as goals of the *Water for Life* strategy.

1.1.4 Phase 4 – Evaluating Water Conservation, Efficiency, and Productivity

Building on the work of the three previous CEP teams, the fourth team was struck in 2015 to evaluate and report on the success of implemented CEP activities.[11]

The purpose of this phase was twofold:

1. Evaluate and report on:
   - the contributions of the water-using sectors' implemented CEP opportunities to achieving the three *Water for Life* strategy's goals
   - the *Water for Life* strategy outcome of a 30% improvement in overall efficiency and productivity from 2005 levels by 2015
   - the AWC-approved CEP desired outcomes (see section 1.1.1)
2. Evaluate the process undertaken by the AWC to achieve CEP objectives and make recommendations for potential future enhancements to sector planning, implementation, and reporting, if needed.

The sectors that developed and implemented CEP plans collectively improved water use efficiency and productivity by 32% over the reporting period, exceeding the 30% target established by *Water for Life*. To build on the progress and ensure the continuation of earlier CEP achievements, four recommendations were made around:

- major water-using sectors continuing to report CEP trends and progress
- continuing collaboration between the major water-using sectors and the GoA to improve the Water Use Reporting System (WURS)
- continuing to raise awareness of and encouraging water use reporting
- the GoA continuing to improve public accessibility to the WURS

10 https://www.awchome.ca/_projectdocs/?file=bdea1052c5201380

11 https://www.awchome.ca/_projectdocs/?file=d86483b3094da16b

1.2 Purpose and Approach

The purpose of this report is to implement Recommendation 1 from the 2017 report *Looking Back: Evaluating Sector Improvements in Water Conservation, Efficiency, and Productivity*:

> "Major water-using sectors collaborate with the Government of Alberta and other partners including the Alberta Water Council to continue reporting CEP trends and progress. Reporting will occur through the Alberta Water Council at five-year intervals using the performance indicators and baseline data in Appendix C (ongoing)."

The major water-using sectors reported progress in implementing their CEP plans according to an agreed schedule and using guidance provided. These update reports provided data on agreed-upon specific water use metrics to show sectors' current status in relation to the initial reporting period. The updates also included contributions to the CEP desired outcomes and contributions to the goals of *Water for Life*. The reports also include commentary on successes and barriers to implementing CEP activities and achieving targets set out in the sector plans. As sectors may have different baseline and reporting years and ways in which CEP metrics are measured, individual sector reports were reviewed to determine how to report and measure the success of implemented CEP opportunities in a consistent manner.

On October 25, 2023, the AWC hosted a session where the seven major water-using sectors who developed sector-level CEP plans provided updates on their sectors' CEP activities.

2. Individual Sector Updates

In summer 2023, CEP sectors were asked to provide updates on the implementation status of Recommendation 1 from the 2017 report *Looking Back: Evaluating Sector Improvements in Water Conservations, Efficiency, and Productivity*. Sectors were provided with a template (Appendix B) and asked to report on the following:

- criteria for success
- sector contributions toward improvement in efficiency and productivity (i.e., how these are measured for a sector)
  - water diversion
  - return flow
  - net use (diversion minus return flow)
  - other relevant sector-specific metrics
- sector contributions toward the three *Water for Life* strategy goals
- implementation and reporting successes and barriers

The information collected was used to populate the following individual sector updates and inform an attempt to quantify the collective results to compare against the original *Water for Life* target of 30% improvement.

When the Phase 4 – Evaluating Water Conservation, Efficiency, and Productivity Project Team evaluated the contributions of the individual sectors in increasing CEP in the initial reporting period, they developed an approach to "roll-up" the collective gains to compare it to the 30% *Water for Life* target. During the initial reporting period, the collective improvement of 32% in water use efficiency and productivity was determined. Many sectors found at the end of the first reporting period that most of their significant CEP gains occurred over that first reporting period, with future CEP advancement expected to be incremental. It should be noted that the 30% target set in *Water for Life* was achieved after this initial reporting period, and no subsequent target was set.

However, because there are significant differences between sectors regarding types of data, reporting periods, and data availability, and circumstances have changed significantly since the initial reporting period (e.g., changes in technology and operations, regulatory changes, population and economic growth), a comparable "roll-up" of the results into a collective percentage change in CEP was not possible for this update; results are instead reported by individual sector. The following sections highlight sector-specific CEP metrics and associated context. A summary of individual sector data for the current reporting period can be found in Appendix C.

2.1 Chemical Producers

The Chemistry Industry Association of Canada (CIAC), in concert with the Canadian Fuels Association (CFA), represents the Chemical and Petrochemical Sector in Alberta on the AWC. However, CIAC and CFA each developed their own independent CEP plans as their operations are sufficiently different regarding water use. Subsequently, Section 2.1 focuses on the Chemical Sector, while Section 2.2 focuses on the Petrochemical Sector, or the Downstream Petroleum Sector.

2.1.1 Sector Highlights and Contributions

For the current reporting period, the Chemical Sector chose 2017 as their baseline year and 2022 as their reporting year. Highlights of this sector's CEP update include:

- 12% increase in overall water diversion for the sector, but an average 22% decrease per CIAC Alberta member
- 6% increase in overall return flow
- 14% increase in overall net use
- 22 facilities reported for 2022, compared to 13 facilities in 2017

Over this reporting period, the sector increased water diversion by 12%, return flow by 6%, and net use by 14% (Figure 4). The sector has seen an increase in total annual water usage which can be attributed to new facilities coming online and increased production capacity since the initial 2005–2015 reporting period. New facilities seize opportunities to innovate by incorporating technology to enable more efficient production, however increased capacity has led to increased water demand, even with more efficient production units.

Despite this increase in total water usage, average water usage has been at a steady decline (22% decrease across all CIAC Alberta members) as capital investments related to stock turnover or expansion have led to the deployment of current technologies that result in increased efficiency and productivity.

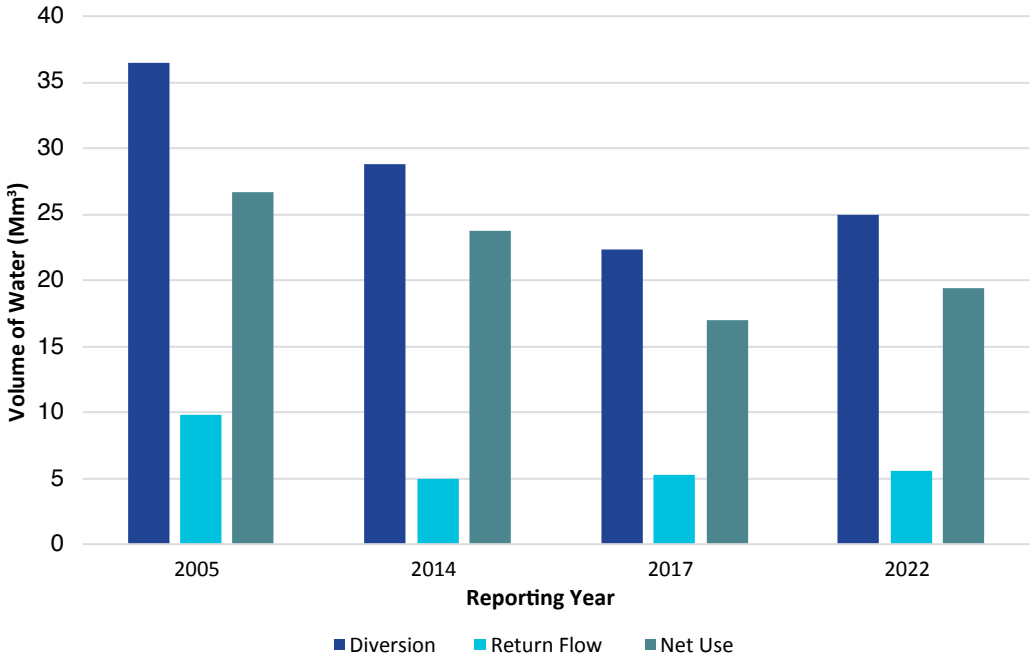

Figure 2. Chemical Sector's water diversion, return flow, and net use since the initial baseline year

2.1.2 Criteria for success

While the Chemical Sector did not set specific targets for usage reductions or efficiency in their CEP plan,[12] the sector has tried to focus on overall water use reduction and has thus established annual reporting on intake and consumption. This ongoing monitoring and data collection will eventually lead to development of a sector-wide metric that, in turn, could allow targets to be set.

CIAC also tracks members' releases of substance to water through the national Emissions Reduction Plan survey.[13] Since 2005, CIAC members have reduced total emissions to water by 54%. In 2020, water emissions represented only 0.0005% of the total 2020 emissions to all media (i.e., air, land, and water).

2.1.3 Implementation and reporting considerations

The most significant improvements in water use for the Chemical Sector, as discussed in its CEP plan, will be made with major capital investments related to stock turnover or expansion. These scenarios will enable older, less efficient equipment to be taken out of service and replaced with current technology, resulting in greater efficiency and productivity.

12 https://www.awchome.ca/_projectdocs/?file=3ba1ee4c7c7df611

13 The most current version of the plan is titled *2030 Emissions Reduction Plan: Clean Air, Strong Economy* and is available here: https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/climate-plan-overview/emissions-reduction-2030.html

On an ongoing basis, smaller efforts will be the drivers of implementing CEP opportunities. It is difficult to set targets, but CIAC has demonstrated that the smaller, year-over-year efficiency improvements do add up to important improvements. These improvements are what the Chemical Sector will purposely work toward in the implementation of the CEP plan.

2.1.4 Additional sector context

Representing companies across Canada involved in the production of basic chemicals and resins for the manufacturing process, the CIAC also represents companies that provide technology services, marketing, and research and development for chemical products.

Government initiatives around net-zero emissions and carbon reduction underscore the importance of the sector's role in driving related innovation and sustainability initiatives. Alberta is well-placed to meet these demands through low-priced feedstock, an educated workforce, and government support which have resulted in the province being a key destination for manufacturing processes.

Member facilities often capitalize on synergies, using the byproducts of one facility as feedstock for another, thereby optimizing resource use and promoting economies of scale in water use and treatment practices.

Water use for the sector involves withdrawing water from the source, transporting it to the facility, treating it for suitable use in chemical processes, and treating it prior to discharging effluent into waterways. While this process is energy-intensive, substantial efforts over the past 20 years have been directed toward reducing energy and making use of resource components more effectively and efficiently to enhance productivity.

2.1.5 Sector contributions to the Water for Life *goals*

The Chemical Sector's contributions to the three *Water for Life* strategy goals are outlined below.

Safe, secure drinking water supplies:

- As part of Responsible Care, a United Nations-recognized sustainability initiative, members are committed to being responsible stewards of water resources by managing their business to conserve and minimize water use, preventing incidents that would be detrimental to water quality or quantity, and controlling effluent streams to protect water bodies, groundwater, and habitat. The Responsible Care Codes also govern members' actions related to the generation, handling, and disposal of hazardous wastes, through all the life cycle stages of research and development, manufacture, transportation, distribution, and the end use and disposal of chemicals and chemical products.

Healthy aquatic ecosystems:

- As it does with other large industrial facilities, Alberta Environment and Protected Areas (EPA), through the Environmental Protection and Enhancement Act (EPEA) and the Water Act, regulate sector operations through comprehensive approvals. Approvals effectively document emission and discharge limits, and specify maximum contaminant levels in the emission or discharge to protect the receiving aquatic system and overall environmental quality. CIAC member companies under Responsible Care commit not only to meet those environmental protection limits but also work to keep the actual emissions and discharges well below those limits.
- CIAC members use various methods of wastewater treatment and return water cleaner than when it was withdrawn.
- Through various industry-led initiatives, CIAC members have reduced total emissions to water by 54% compared to 2005 levels. For example, Inter Pipeline Ltd. partnered with the Northern Alberta Institute of Technology and fellow industry member Dow Canada to undertake the Plastics Research in Action (PRIA) initiative. This multi-disciplinary research program led by industry and research experts focused on exploring opportunities for society to reuse and recycle plastic waste. The Microplastics Project is one of PRIA's major research initiatives.[14] It is focused on developing methods to identify and quantify microplastics in freshwater and river sediments. The goal of this project is to optimize protocols that can accurately and efficiently evaluate types of microplastics in the North Saskatchewan River.

Reliable, quality water supplies for a sustainable economy:

- Each facility has a relatively fixed water use volume based on plant design and operating rates. Generally, if a plant runs at less than capacity it used less water.

2.2 Downstream Petroleum Products

The Downstream Petroleum Sector is represented by the CFA which includes:

- crude oil refiners
- an asphalt producer
- product distribution terminals
- associated pipelines
- truck, rail, and marine transportation
- retail/wholesale gasoline, diesel, and lubricant marketers

14 https://www.nait.ca/applied-research/our-work-and-impact/plastics-research-in-action

2.2.1 Sector highlights and contributions

For the current reporting period, the Downstream Petroleum Sector chose 2017 as their baseline year and 2021 as their reporting year. Highlights of this sector's CEP update include:

- 32% increase in water diversion
- 7% increase in return flow
- 48% increase in net use
- 32% decrease in water productivity[15]
- 11% increase in production output
- Four refineries reporting, compared to three in 2017

Over this reporting period, water diversion increased by 32%, return flow increased by 7%, and net use increased by 48% (Figure 5). Despite production output increasing by 10% from 2017–2021, the sector's productivity has decreased by 32% (Figure 6).

Increased water demand over this reporting period has been influenced by:

- the response to environmental regulations and societal demand for cleaner air and fuels
- market demand, including a new greenfield refinery commissioned in 2019
- increasing heavy versus light crude feedstock requiring refinery reconfigurations
- the implementation of carbon capture, use, and storage (CCUS) at two Alberta refineries

As a result of these combined factors, the sector has seen an increase in energy consumed in refining process units, which has been accompanied by increased water use. The increasing complexity and intensity of refinery processing has resulted in increased process heat requirements and more cooling water needed for process units. The sector continues to conduct research and development to pursue further reductions in water use and improve the quality of their discharges.

15 The Downstream Petroleum Sector defines productivity as the volume of water used to process one cubic metre of crude oil.

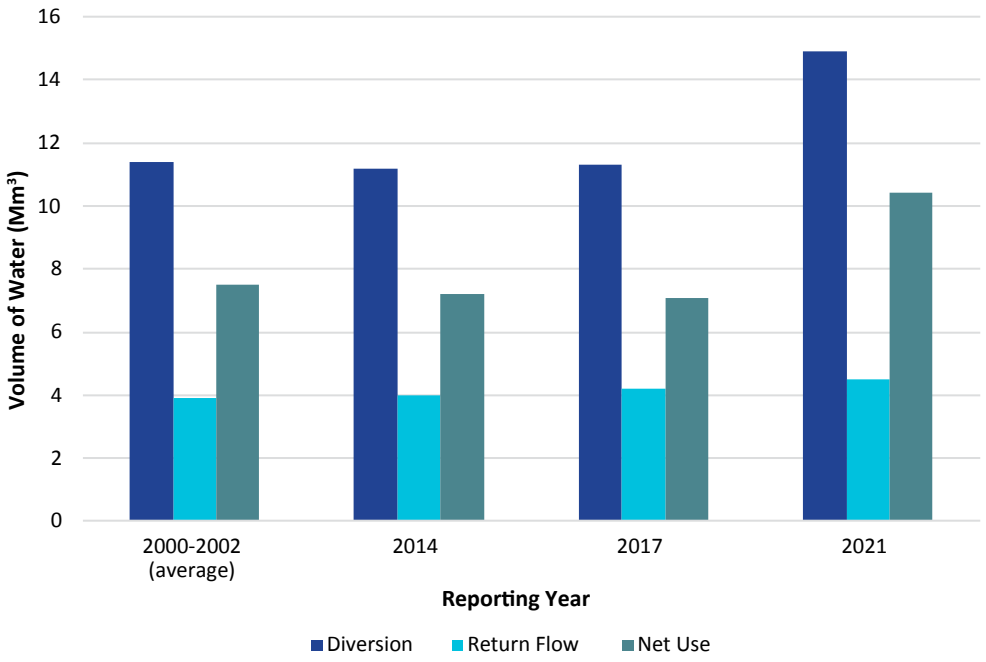

Figure 3. Downstream Petroleum Sector's water diversion, return flow, and net use since the baseline year

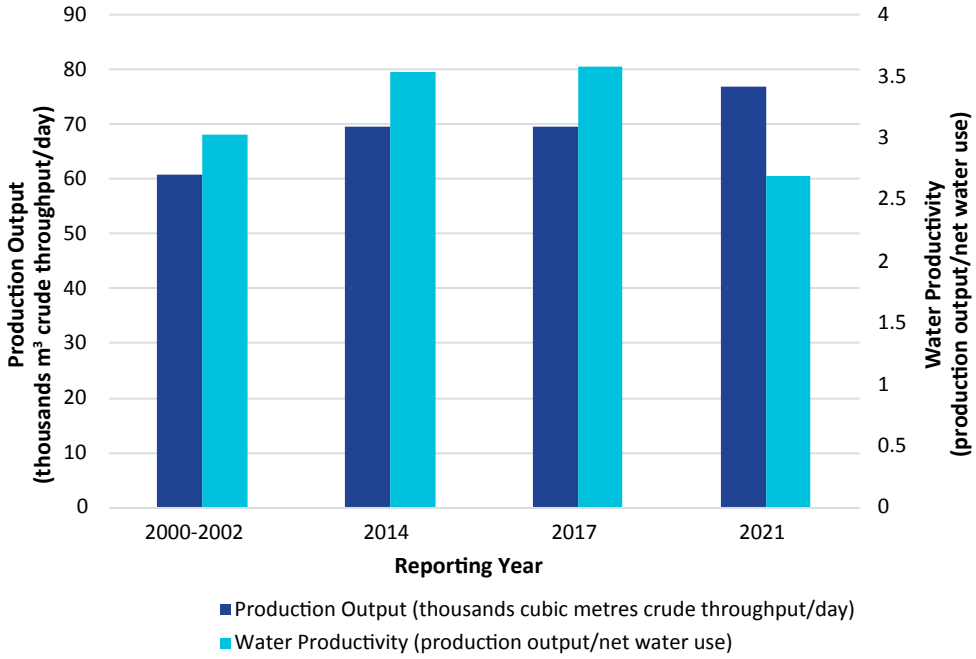

Figure 4. Downstream Petroleum Sector's production output and water productivity since the initial baseline year

2.2.2 Criteria for success

The Downstream Petroleum Sector did not set specific targets in its 2012 CEP plan. However, the sector aims to continuously improve water productivity while recognizing that increasingly stringent environmental and fuel quality parameters require additional processing in the refining of crude oil to finished products. The sector also aims to maintain or improve refinery effluent quality.

2.2.3 Implementation and reporting considerations

In recent years, many fuel product quality (i.e., low sulphur fuel regulations) and environmental initiatives, and more recently, greenhouse gas (GHG) reduction requirements, have been implemented at both provincial and federal levels. This has resulted in the reconfiguration of some refining operations and the addition of energy-intensive units that require additional cooling water. An example at two of Alberta's four refineries is the capture of CO_2 streams which are then sequestered underground.

Changes in refinery feedstock quality over the reporting period to a heavier crude slate have also demanded use of technologies that are more water intensive.

2.2.4 Additional sector context

In refineries, approximately 60% of intake water is used in a continuous recycling loop for process unit cooling. Approximately 35–40% of water is used in the refining process by direct contact with crude oil or production of steam and hydrogen. Evaporative loss from cooling and refinery processing is included as consumption. Approximately 1% of intake (including water from municipal sources) is used for sanitation. Residual cooling water and process contact water from refinery operations is treated in onsite wastewater treatment plants to release quality before it is returned to the environment. Approximately 10% of water is used for activities such as the generation of hydrogen and fire water. Marketing and distribution operations are not significant users of water and typically source water from municipal systems and, occasionally, from groundwater sources.

2.2.5 Sector contributions to the Water for Life goals

The Downstream Petroleum Sector's contributions to the three *Water for Life* strategy goals are outlined below.

Safe, secure drinking water supplies:

- CFA member refiners in Alberta are licensed to source water withdrawals from the North Saskatchewan River. The provincial *Waste Water Effluent Guidelines for Alberta Petroleum Refineries-1985* define the minimum acceptable levels for wastewater treatment at refineries. Permits or licences for petroleum refining plants issued under the provincial *Water Act*, R.S.A 2000 will only be issued if there is provision for an effective control program for plant liquid effluents originating from the refinery process units, surface runoff from the developed area within property boundaries, and sanitary sewage.

Healthy aquatic ecosystems:

- Although the most obvious CEP opportunities with the largest gains have already been implemented, the Downstream Petroleum Sector continues to conduct research and development to pursue further reductions in water use and improve the quality of their discharges.
- In general, water withdrawn from the source by CFA member refiners is used, treated, and returned to source at an equivalent or better quality than source water intake.

Reliable, quality water supplies for a sustainable economy:

- This goal is met by the Downstream Petroleum Sector's small water use footprint as it is a relatively small water user compared to other industry sectors in the province. The sector's water use represents ~0.1% of Alberta's total water allocation and ~2% of Alberta industry's water allocation.

2.3 Forestry

Alberta's Forestry Sector is represented by the Alberta Forest Products Association (AFPA) on the AWC. Within this sector, the pulp and paper sub-sector represents the only significant surface water licensed withdrawals in terms of volumes. Hence, the pulp and paper industry is the focus of the sector's CEP plan.[16]

2.3.1 Sector highlights and contributions

For the current reporting period, the Forestry Sector chose 2009 as its baseline year and 2019 as its reporting year. Highlights of this sector's CEP update include:

- 12% increase in water diversion
- 15% increase in return flow
- 15% decrease in net use
- 4% increase in water productivity

To get an overall impression of water intake for the sector, average daily intake rates were aggregated for mechanical and kraft mills. While the sector has seen a 12% increase in water diversion from baseline (Figure 7), data analyzed from 2009–2019 indicate the sector's overall volume of water used in production processes has remained relatively constant since 2009. Net water usage was also analyzed and seen to have decreased by 15%. Net water usage decreased by 15% and production output increased by 16%. The net gain in productivity was improved by 4%, just short of the sector's 5% target (Figure 8). Research and advancements in technology have led to these improvements in productivity across Alberta's pulp and paper mills.[17]

16 https://www.awchome.ca/_projectdocs/?file=b6efcc1d17b2128b

17 The Forestry Sector defines productivity as the volume of water used to produce one dry metric tonne of pulp.

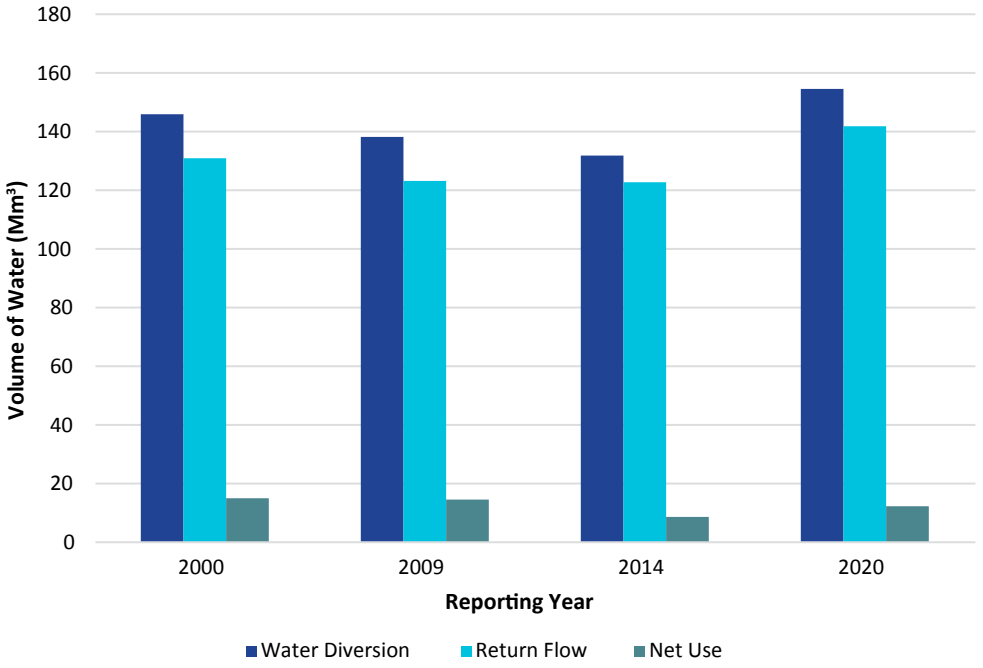

Figure 5. Forestry Sector's water diversion, return flow, and net use since the initial baseline year

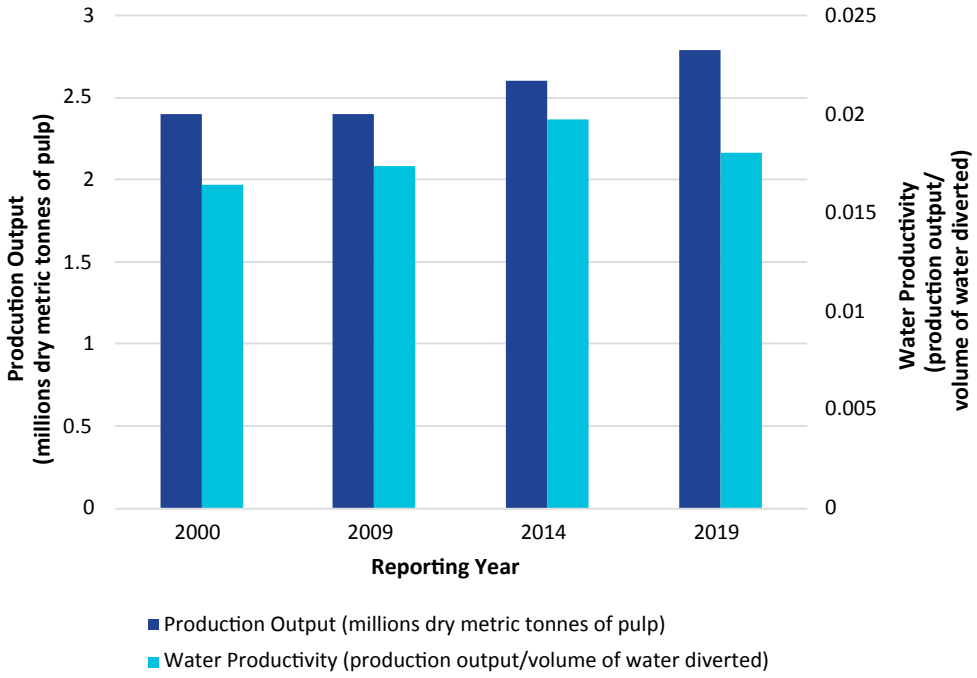

Figure 6. Forestry Sector's production output and water productivity since the initial baseline year

2.3.2 Criteria for success

In 2011, Alberta's pulp and paper sector committed to three goals toward continuous improvement in its CEP plan:

- Keep water withdrawals and returns from Alberta's seven pulp and paper mills at baseline (2009) or improved levels.
- Use research and technology to improve productivity by a further 5% over the next decade (2011–2020).
- Continue to work with partnerships to improve water quality and ensure aquatic ecosystems are healthy.

2.3.3 Implementation and reporting considerations

Shutdowns and interruptions to the pulp process tend to increase water consumption in pulp mills. Mill operations and water consumption are closely tied to power pricing. Thus, pulp mill production may be curtailed to control energy use during volatile periods of high electrical costs. For example, water recycling operations may have to be shut down which leads to increased water diversion and use. In 2020, curtailed operations and necessary accommodations for COVID-19 health and safety protocols contributed to longer periods of mill downtime and elevated water intensity usage at a few of the impacted facilities.

2.3.4 Additional sector context

Alberta's seven pulp and paper mills are licensed to withdraw less than 1% of annual river discharge on the Peace and Athabasca Rivers. The AFPA works with Alberta's pulp and paper mills to identify opportunities for CEP, drawing from provincial, national, and international experience. CEP initiatives to be undertaken and implemented are decided by each facility independently.

Water consumption is greatly influenced by the different production processes for the products manufactured by the sector. Solid wood mills (lumber and engineered wood) use little process water compared to the volume of water required for pulp processing in pulp facilities. Solid wood mills use water for cleaning, fire protection, steam generation, Wet Electrostatic Precipitator operation, misters for dust control, and to cool equipment. At three sawmill sites, water is also employed in a closed-loop system for the cooling needs of three biomass-fuelled organic Rankine cycle bioenergy systems.

Water use is most relevant for the higher water demand processes of the pulp operations. Water is used to wash and process pulp, transport it through the mill, cooling process effluent for effective environmental treatment, and for heat and power generation. The total volume of water required in facilities varies by the type and configuration of mill processes.

2.3.5 Sector contributions to the Water for Life goals

The Forestry Sector's contributions to the three *Water for Life* strategy goals are outlined below.

Safe, secure drinking water supplies:

- The Forestry Sector regularly engages with and participates in projects led by the AWC, the Athabasca Watershed Council, other Watershed Planning and Advisory Councils (WPACs), and the National Council for Air and Stream Improvement to continue to learn and develop relationships that improve the sector's ability to be water stewards.

Healthy aquatic ecosystems:

- Water not withdrawn by Alberta's pulp and paper mills remains in the river and continues to benefit aquatic health. Additionally, most of the water withdrawn (94%) is returned to the river.

Reliable, quality water supplies for a sustainable economy:

- As with the goal of healthy aquatic ecosystems, returning quality effluent to river systems ensures reliable, quality water supplies for a sustainable economy.

The following case studies were submitted by the Forestry Sector to further highlight their members' efforts in achieving CEP and contributing to the three *Water for Life* strategy's goals:

- Alberta Newsprint Company (ANC) has implemented two phases of paper machine whitewater recovery from the paper machine loop. Water that normally would have been sewered is now reused in the pulping process for chip washing and dilution. This has resulted in almost 3.0 m^3/FMT (finished metric tonnes) production since implementation or 750,000 m^3 per year. ANC is currently working on a plan for Phase 3 of the whitewater recovery project. This would involve operating a dissolved air flotation unit to clean whitewater for reuse on the paper machine as shower water. This could result in a further 3.0 m^3/FMT reduction.
- International Paper (IP) has identified a corporate goal of 25% water use reduction to be reached by 2030. To date, Alberta's IP mill has contributed to that goal by not using 27.9 million gallons of water. This has been achieved through the completion of various small projects such as reducing water usage during rinsing out chemical totes, increased focus on turning off washing hoses, and fixing infrastructure equipment leaks. In addition, IP has various process-related projects in review that will continue to help them meet the 2030 goals. They are rated number one for water use intensity according to the 2021 Forest Products Association of Canada Energy and Environment survey results.
- In 2017, Millar Western's Whitecourt pulp mill launched its bioenergy plant as a means of converting a waste stream to energy. This facility uses innovative anaerobic hybrid digester technology to generate biogas from organics in mill effluent. Once cleaned, the biogas is used to generate renewable power and heat for mill use. The pulp mill's current two-stage

effluent treatment system has reduced our consumption of fossil fuels, significantly cut our GHG emissions, lowered our freshwater intake, improved water quality, and decreased operating costs.

- In 2021, Alberta Pacific Forest Industries commissioned the Stack Heat Recovery Unit which uses the waste heat from most of the recovery boiler flue gas for heating water for process use; the condensation from flue gas is recovered and estimated to be 7.5–10.5 L/s back to the watershed (previously this condensate would have been lost to vapour to the airshed).
- At West Fraser's Alberta facilities, all the process water used for pulping is reused several times in manufacturing processes before it is treated and released back to the environment, with 94% of withdrawn water returned. Water consumption loss is closely tracked, with the largest contributors being steam or evaporative losses, and the moisture of the biosolid residuals from the pulping process.
- Mercer Peace River has operated its Nutriboost program since 2003. A beneficial reuse initiative, the program provides local farmers with valuable nutrients contained in biosolids from our treatment facilities. Through the Nutriboost program, a waste product has effectively been transformed into a rich source of organic fertilizer that includes nitrogen, phosphorus, potassium, and organic matter.

2.4 Irrigation

The Alberta Irrigation Districts Association (AIDA) represents the Irrigation Sector in Alberta on the AWC.

2.4.1 Sector highlights and contributions

The Irrigation Sector chose 2005 as its baseline year and 2020 as its reporting year. Highlights of this sector's CEP update include:

- 9.8% decrease in water diversion
- 20% decrease in return flow
- 7.2% decrease in net use
- 27% increase in water productivity
- 8.8% increase in production output
- 17% increase in diversion efficiency

Several of the sector's CEP targets are specific to the 2005–2015 period. During the 2005–2015 reporting period, all targets identified were met. Figure 9 provides a comparison of the Irrigation Sector's water diversion, return flow, and net use between 2005 and 2020. Production output and productivity are highlighted in Figure 10.

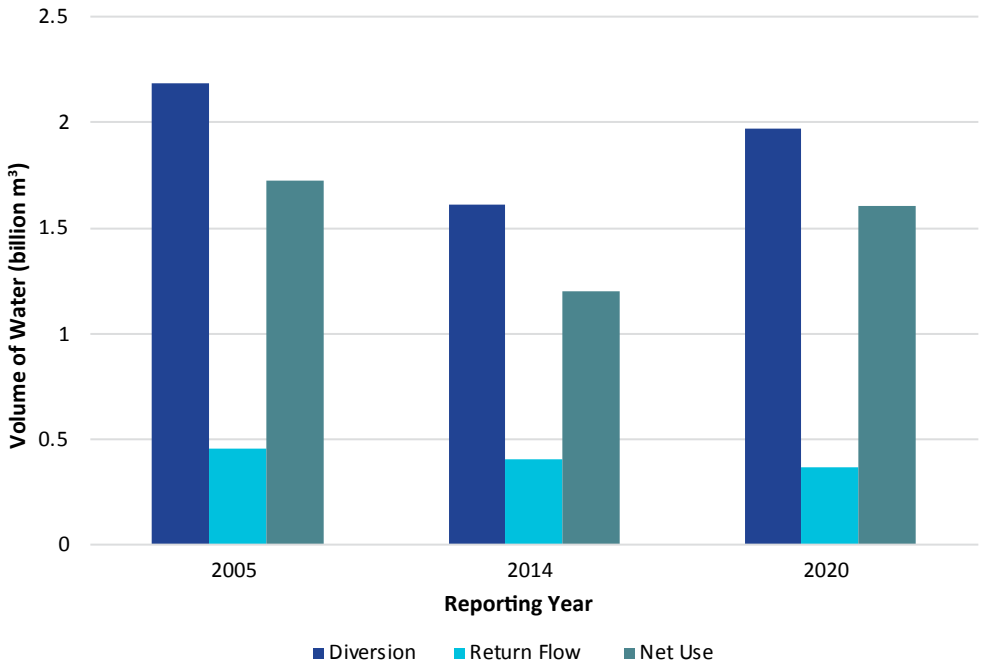

Figure 7. Irrigation Sector's water diversion, return flow, and net use since the initial baseline year

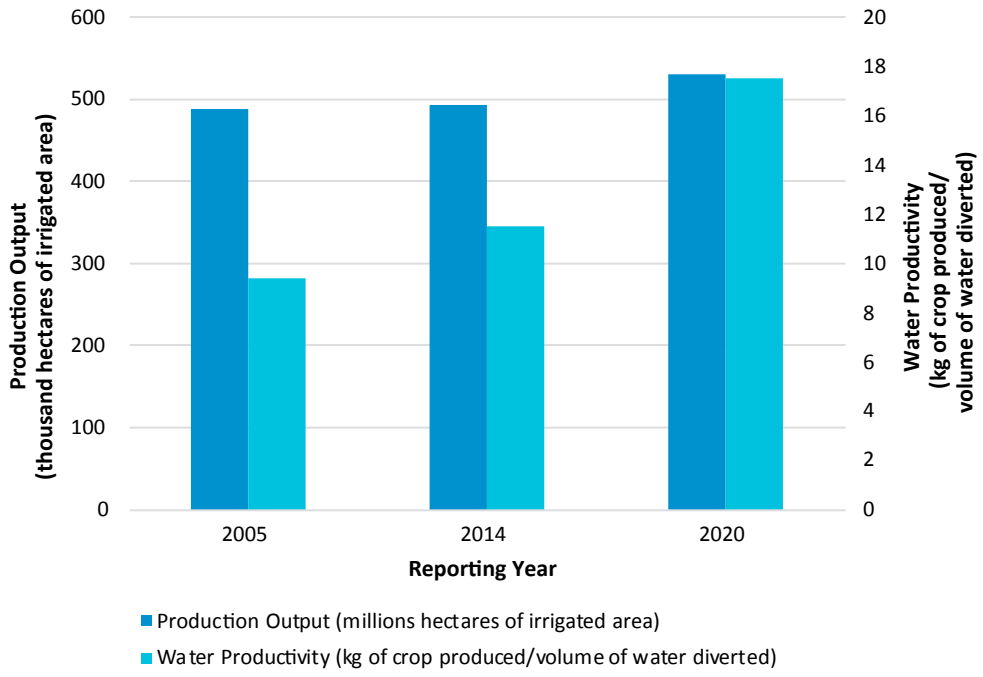

Figure 8. Irrigation Sector's production output and water productivity since the initial baseline year

In the time since the last reporting period, several of the targets continue to be met and should be noted including:

- Efficiency gains of 17% and productivity gains of 27% through the period 2005–2020 mean the Irrigation Sector continues to make gains in combined CEP.
- 81.5% of lands in the districts are irrigated by low-pressure drop-tube pivots. This is an increase of 10% from 2014 and 34% from 2005 levels.
- On a ten-year rolling average, irrigation districts continued to keep diversions at or below the year 2005 reference benchmark of 2.186 billion m^3 per year with the 2020 average diversion being 1.972 billion m^3.
- Districts continue to make water available under their licences for other purposes; 2.8% of the licenced volume for irrigation is assigned by districts for other uses. At the end of 2020, 78,228 acre-feet were assigned to other purposes.
- Saved water continues to allow irrigation districts to expand their assessed area. The assessed area of irrigation districts increased 5.4% from 2015–2020.
- The average volume of water diverted by irrigation districts per unit of irrigated area continues to remain below the 2005 benchmark of 445 mm with the 2020 average value being 369 mm.
- Using the average water diversion per unit of land irrigated as a measure of efficiency gains, the Irrigation Sector saw overall gains of 17% for the period 2005–2020.
- The productivity of the indicator crops of sugar beets and potatoes to the end of 2020 was 27%.

2.4.2 Criteria for success

The original Irrigation Sector CEP plan identified eight individual targets:[18]

1. The Irrigation Sector will achieve a 30% increase in combined CEP from 2005–2015.
2. By the year 2015, 70% of irrigated lands in districts will be under best management practices, namely low-pressure drop-tube centre pivots, an increase from the 47% documented in 2005.
3. On a ten-year rolling average, the irrigation districts will keep diversions at or below the year 2005 reference benchmark of 2.186 billion m^3 per year.
4. Within regulations and using water conserved in the irrigation system the Irrigation Sector will make additional water available for other uses such as food processing, environmental objectives, rural water networks, agribusiness, and other water sharing.
5. Growth in irrigation districts will occur using saved water.

18 https://www.awchome.ca/_projectdocs/?file=ec77132c507a8809

6. On a ten-year rolling average through 2015, irrigation districts will reduce the volume of water diverted from Alberta's rivers, lakes, and streams per unit of irrigated area to a level below the 2005 benchmark of 445 mm.
7. The Irrigation Sector will achieve a 15% increase in efficiency, relative to 2005 levels, by the end of 2015.
8. The Irrigation Sector will increase its productivity by 15% from the reference yield of 2005, based on the indicator crops of sugar beets, potatoes, and soft white wheat.

2.4.3 Implementation and reporting considerations

During the first CEP reporting period, the gains achieved by the Irrigation Sector were considerable and coincided with a significant pace of irrigation infrastructure upgrades and on-farm application system conversions. As predicted during the first reporting period, overall improvements in efficiency and productivity are now occurring at a slower rate due to reaching the maximum amount of land able to accommodate low-pressure centre pivot irrigation and limitations around infrastructure rehabilitation.

The amount of land under low-pressure centre pivot systems at the end of 2020 was 81.5% which is above the long-term target of 80%. The estimated maximum amount of land which can accommodate a low-pressure centre pivot is 85–90%.

Infrastructure rehabilitation has continued since the last reporting period. In 2020, 58% of the 7,653 kilometres of district-owned linear infrastructure was buried pipeline which was an increase of 6% since 2014 and 24% since 2005. Manufacturing and construction technology are now allowing larger pipe to be installed to replace larger volume lateral canals. This expansion will offer additional efficiency improvements in the coming years.

A significant barrier encountered during this reporting period related to the calculation of the productively of irrigation-specific indicator crops. Historically, three indicator crops (potatoes, sugar beets, and soft white wheat) grown specifically under irrigation were chosen to inform this value. Production values for these crops are obtained through information compiled by Alberta Agriculture and Irrigation. In 2015, annual reporting of production values for soft white wheat was terminated.

For the current CEP reporting period, the productivity of the indicator crops of only potatoes and sugar beets were calculated for the 2005–2020 reporting period.

2.4.4 Additional sector context

The bulk of irrigation in the province is found within 11 irrigation districts located in southern Alberta, which covers approximately 1.5 million acres of irrigated area. Irrigators have collective ownership of the conveyance infrastructure through their local irrigation district. Additionally, districts own 41 irrigation storage reservoirs located throughout the region for storing water

when it is available to be diverted from the rivers for use during the later part of the irrigation season and throughout the year for other users.

Irrigation water use is variable and highly dependent on the amount of precipitation received and temperatures occurring over the irrigated region during the irrigation season. The Irrigation Sector uses ten-year averages to show trends in the sector's water use to account for variability from weather. Water efficiency gains within the sector are achieved by improving district conveyance infrastructure and by improving on-farm irrigation application systems.

2.4.5 Sector contributions to the Water for Life *goals*

The Irrigation Sector's contributions to the three *Water for Life* strategy goals are outlined below.

Safe, secure drinking water supplies:

- AIDA Human Use of Water and Livestock Sustenance Declaration commits irrigation district members to supplying water for human sustenance and livestock water needs prior to supplying water for irrigation needs during periods of low water supply due to drought.[19] Due to a predicted low water supply for the 2024 water season and supporting the declaration, irrigation districts participated in Water Sharing Memorandums of Understanding with other water licensees to facilitate the sharing of available water within the South Saskatchewan River Basin. As a result, some districts reduced the on-farm water allocation to their irrigators by 50%.
- The irrigation conveyance system continues to provide water access to over 30 communities, rural waterline cooperatives, and thousands of rural farmyards and acreages.
- Efficiency gains also help support the transfer of water licence volume to other users. Irrigation districts have participated in licence transfers with municipalities.
- The Irrigation District Water Quality Monitoring Program monitors water quality within irrigation canal infrastructure in collaboration with the GoA with all data being publicly available.[20] Long-term trends continue to demonstrate excellent quality of water flowing through irrigation conveyance infrastructure. Though water quality evaluation within this program is specific to recommendations for irrigation use, the results demonstrate the quality of water being accessed by many municipalities for drinking water treatment is in an acceptable condition.

19 https://drive.google.com/file/d/1wD5jKk2quy9knimY1sCdUxju9kuh_Mhz/view?usp=share_link

20 http://www.idwq.ca/

Healthy aquatic ecosystems:

- Dynamic water diversions support in-stream objectives and functional flow objectives.
- Data from the Irrigation District Water Quality Monitoring Program continues to demonstrate maintenance or improvement of the quality of water as it flows through irrigation districts and is returned to source rivers, ultimately supporting healthy aquatic ecosystems.
- Over 50 irrigation storage reservoirs used for irrigation also support fish habitat.
- Water diversion and delivery supports over 550 km^2 of constructed wetland projects.
- AIDA supports and promotes the province's Aquatic Invasive Species Program which involves inspection, enforcement, prevention, and monitoring of aquatic invasive species.[21]

Reliable, quality water supplies for a sustainable economy:

- Rehabilitation and modernization of irrigation district conveyance infrastructure increases the security and reliability of water conveyance to all users encouraging continued economic development.
- Water savings used to expand irrigated area within irrigation districts allows an increase in the production of high-quality and high-yielding agricultural product which supports Alberta value-added processing facilities and primary agriculture sales.
- Value-added processors and commodity organizations continue to use data obtained from the Irrigation District Water Quality Monitoring Program to demonstrate high-quality irrigation water is used to grow primary product to maintain and expand export markets.
- Districts continue to offer water through their licences for other purposes including to support municipal, agribusiness, industrial, and commercial purposes.
- Efficiency gains help support the transfer of water licence volume to other users.

2.5 Upstream Oil and Gas

The Canadian Association of Petroleum Producers (CAPP) represents Alberta's Upstream Oil and Gas Sector on the AWC.

2.5.1 Sector highlights and contributions

The Upstream Oil and Gas Sector chose 2017 as its baseline year and 2022 as its reporting year. Highlights of this sector's CEP update include:

- 1% increase in water diversion
- 15% improvement in water productivity (non-saline water use intensity)
- 23% increase in production output

21 https://www.alberta.ca/aquatic-invasive-species-overview

The oil and gas sector had the fourth highest water allocation in the province in 2022, representing 12% of the total volume allocated to all sectors. Despite hydrocarbon production increasing by 23% over the reporting period of 2017–2022 (Figure 10), non-saline water diversion increased by just 1% (Figure 9).

The Upstream Oil and Gas Sector is comprised of the following sub-sectors:

- Oil sands mining
- In situ oil sands
- Enhanced oil recovery
- Hydraulic fracturing

As the oil sands mining sub-sector is responsible for 82% of the sector's non-saline water use, it drives the sector's overall water use performance.

Between 2017 and 2022, the sector average non-saline water use intensity decreased (i.e., water productivity improved) by 15%. This performance improvement can be attributed to the following factors:

- High rates of water recycling. Despite increasing hydrocarbon production, increased water needs are met with recycled water. Of the total water used for oil and natural gas development in Alberta in 2022, about 80% is recycled water.
- Sourcing alternatives to high-quality non-saline water, such as deep saline groundwater, low-quality non-saline groundwater, and treated municipal or industrial wastewater.
- Continued advancement of, collaboration on, and communication of research and development of new technologies that further reduce non-saline water use in oil and natural gas operations through Canada's Oil Sands Innovation Alliance (COSIA) and the Alberta Upstream Petroleum Research Fund (AUPRF).
- Process optimization to improve water use efficiencies in operations.
- Regulatory changes were advanced to support water reuse and alternative water use in oil and natural gas operations.

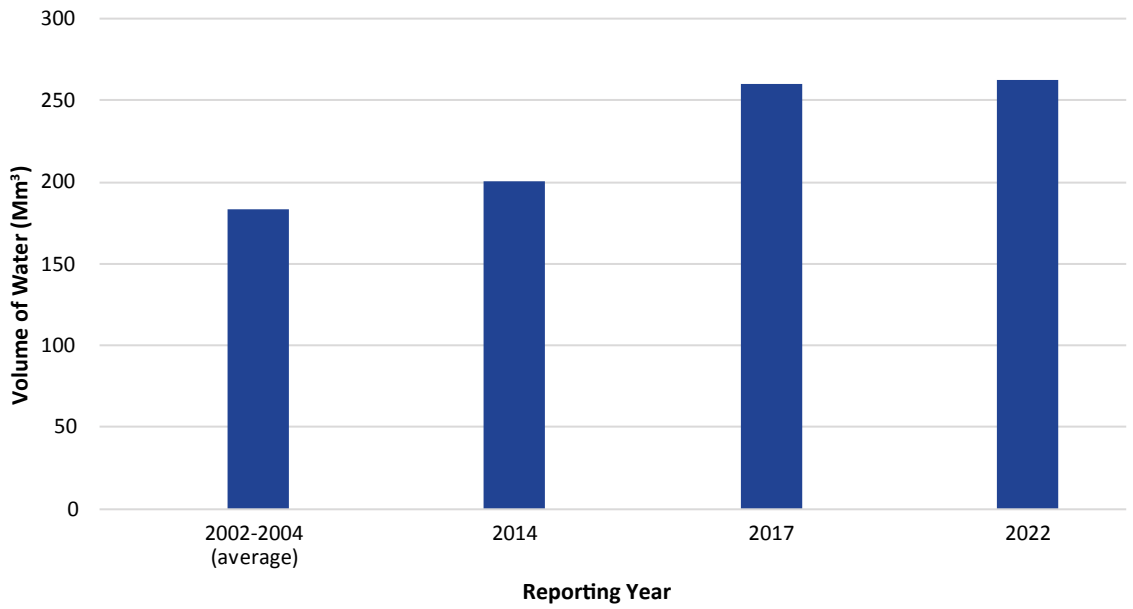

Figure 9. Upstream Oil and Gas Sector's water diversion since the initial baseline year. As current regulations do not permit the sector to return treated wastewater to the environment, the sector does not report return flow or net use.

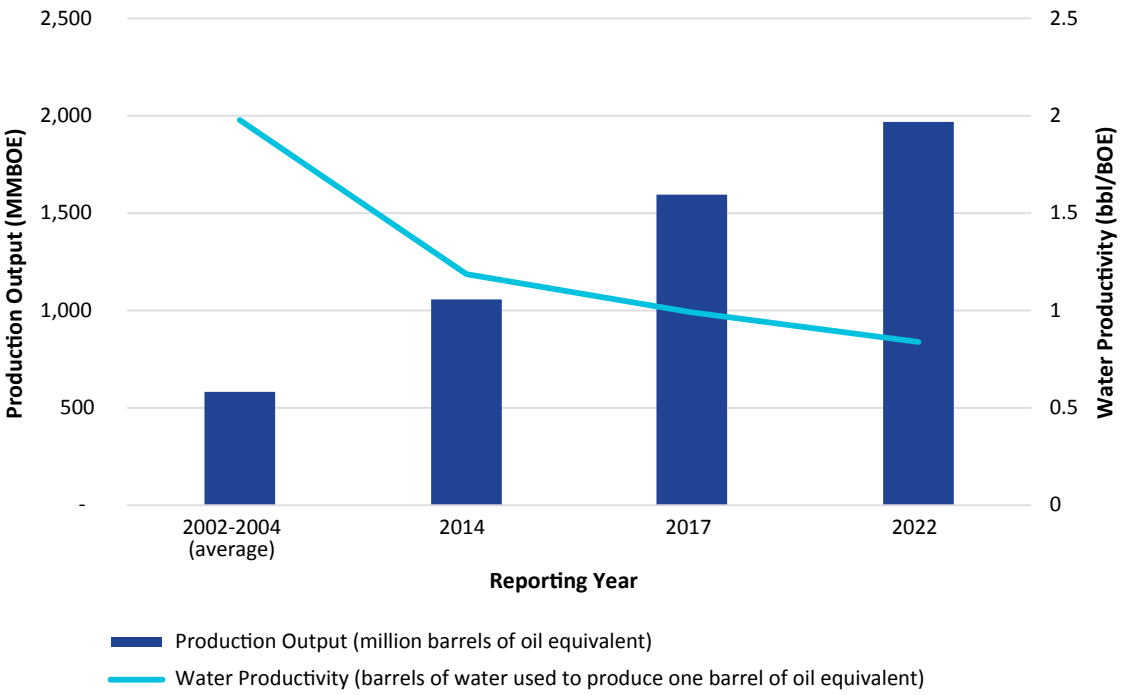

Figure 10. Upstream Oil and Gas Sector's production output and water productivity since the initial baseline year

(The Upstream Oil and Gas Sector's initial baseline year and reporting year did not include hydraulic fracturing, since this data was not available at the time. Units were converted for consistency with the current reporting period.)

2.5.2 Criteria for success

For this reporting period, the Upstream Oil and Gas Sector wanted to maintain or improve sector water productivity (i.e., non-saline water use intensity), expressed as the number of barrels of non-saline water needed to produce one per barrel of oil equivalent (BOE).

2.5.3 Implementation and reporting considerations

Each of the upstream extraction technologies (i.e., oil sands mining, in situ oil sands, enhanced oil recovery, and hydraulic fracturing) have different opportunities and barriers for further CEP improvements. There is no one-size-fits-all approach to improving water use intensity. Every project is unique, and water use intensity depends on several factors, including extraction technology used, project stage (construction, start-up, mature), type of production, reservoir geology/quality/characteristics, availability of alternative water sources, source water quality, seasonal/climate variability, and existing water infrastructure to store water for reuse.

The sector has identified the following barriers in CEP implementation and reporting:

- While water use performance improvements continue to be important, the sector is highly focused on reducing emissions and on reclamation/closure.
- Although incremental improvements are still being made, the CEP opportunities with the largest gains were implemented pre-2012.

Water recycling rates in the hydraulic fracturing sub-sector remain relatively low. In 2023, the sector initiated a study through AUPRF to examine the technical, economic, and regulatory barriers. Two barriers include:

- Availability of cost-effective technologies to treat sour water (i.e., wastewater containing hydrogen sulphide) for reuse.
- Reputational, regulatory, and environmental risks associated with potential leaks or spills when moving or storing sour water for reuse.
- Oil and gas effluent release criteria have not yet been developed to enable the safe return of industrial wastewater to the aquatic environment. Since the sector is not permitted to return treated wastewater, most of the sector's water use is consumptive.
- Oil sands mines will be unable to achieve reclamation and closure plans/commitments without a regulatory framework to enable release of treated mine water.

2.5.4 *Additional sector context*

Sector accountability for water use performance is maintained through the Alberta Energy Regulator (AER) and details are published in an annual industry water use performance report.[22] Published annually since 2017, it reports on the upstream oil and natural gas sector's water allocation volumes, actual water use volumes, water recycling rates, and non-saline water use intensity. This data is reported for the total sector, by sub-sector, and by company. It also provides context for performance trends. The 2023 report, published in December 2024, is the source of the 2017 and 2022 Upstream Oil and Gas Sector data reported here.

2.5.5 *Sector contributions to the* Water for Life *goals*

The Upstream Oil and Gas Sector's contributions to the three *Water for Life* strategy goals are outlined below.

Safe, secure drinking water supplies:

- Strict regulations are in place to ensure oil and gas wellbores are designed, constructed, and maintained to prevent migration of methane gas and fluids into groundwater.
- As a best practice, companies test domestic water wells in the vicinity prior to undertaking hydraulic fracturing operations.
- Through AUPRF, the sector provides open access to the Alberta Water Tool to support accessible web-based public information and water management decision making.[23]

Healthy aquatic systems:

- Oil and gas companies must obtain a Water Act licence to divert non-saline water. All water withdrawals are measured and reported to the AER. Additionally, licences contain conditions to monitor the rate of flow, water levels in lakes, water temperature, and dissolved oxygen concentration to ensure the aquatic environment is protected.
- Where possible, operators withdraw water during times of high flow and store water in reservoirs for later use. This avoids withdrawals during periods of low flow or drought, minimizing aquatic impacts.

The sector is subject to sector-specific water policy and regulations in Alberta that promote water conservation and efficiency. For example:

- The Government of Alberta's Water Conservation Policy for Upstream Oil and Gas Operations (2020)[24] articulates a preference for the sector's use of alternative sources over high-quality, non-saline water.

22 https://www.aer.ca/protecting-what-matters/holding-industry-accountable/industry-performance/water-use-performance

23 https://alberta-watertool.com/

24 https://open.alberta.ca/publications/water-conservation-policy-for-upstream-oil-and-gas-operations

- AER Manual 025: Applications Under the Water Conservation Policy for Upstream Oil and Gas Operations[25] requires that upstream oil and gas operators applying for water licence applications, renewals, and amendments to assess the feasibility of all reasonable alternatives to conserve high-quality, non-saline water.
- AER Directive 081: Water Disposal Limits and Reporting Requirements for Thermal In Situ Oil Sands Schemes imposes water disposal limits on thermal in situ oil sands operators. This means operators must increase produced water recycling in operations.
- The Government of Alberta's Surface Water Quantity Management Framework (SWQMF) establishes weekly management triggers for the lower Athabasca River[26] based on seasonal variability and river flow to meet identified human and ecosystem needs. The AER is responsible for implementing these weekly operational triggers and limits on oil sands mine water withdrawals and the associated annual agreement between companies defined in the SWQMF to ensure the Athabasca River remains highly protected.

- The sector carefully manages wastewater in its operations to avoid contamination of aquatic ecosystems. Since the sector is not permitted to treat industrial wastewater and return it to the natural environment, water diverted for use must be either safely stored, recycled or disposed deep underground.
- Fish screens are used on water intake pipes to protect fish and fish eggs.
- Reliable, quality water supplies for a sustainable economy:
- The Upstream Oil and Gas Sector is a key driver of the Alberta and Canadian economies. In 2022, high energy prices driven by the Russian invasion of Ukraine and global demand recovery following the COVID-19 pandemic led to record-breaking production and associated economic benefits.
- In fiscal year 2022–2023, Alberta's non-renewable resource revenue was $25.2 billion, accounting for approximately 33% of the provincial government's total revenue. This figure excludes corporate, personal, or municipal taxes. Source: Government of Alberta, 2024–27 Fiscal Plan, page 11[27].
- Total capital expenditure in Alberta's upstream oil and gas sector was $28.4 billion in 2024.
  - This included $16.5 billion in investment spending in crude oil and natural gas and $11.9 billion in the oil sands.[28]

25 https://static.aer.ca/prd/documents/manuals/Manual025.pdf

26 https://open.alberta.ca/publications/9781460121733

27 https://open.alberta.ca/dataset/23c82502-fd11-45c6-861f-99381fffc748/resource/3782cc8f-fdc4-4704-9c50-07fc36e05722/download/budget-2024-fiscal-plan-2024-27.pdf

28 https://www.aer.ca/data-and-performance-reports/statistical-reports/alberta-energy-outlook-st98/prices-and-capital-expenditure/capital-expenditures

- Approximately 124,500 people were directly employed in Alberta's upstream oil and gas sector in 2022.
- 79,500 people were employed in oil and gas extraction and 45,000 people were employed in support activities.[29]

2.6 Power Generation

The Power Generation Sector is represented on the AWC by Heartland Generation, TransAlta, and Capital Power.

2.6.1 Sector highlights and contributions

The Power Generation Sector chose the average of 2000–2002 as their baseline year in the original sector plan. This baseline period was selected because of the availability of comprehensive data and the start of a natural transition in electric power generation technologies. For this update the baseline period has been retained to provide consistency and 2022 has been selected as the reporting year. Highlights of this sector's CEP update include:

- 9% decrease in net use
- 57% increase in water productivity
- 42% increase in production output

Over the reporting period (2017–2022), the sector achieved a 15% reduction in net water use, 16% increase in water productivity, and a 1% decrease in production. Improvements in CEP can be attributed to the following:

- The change in generation mix and technology. During the baseline period, 70% of the province's electricity was provided by coal, 25% was natural gas, 3% was hydroelectric, and wind and solar were negligible. In 2022, coal-generated electricity only accounted for 12% of the generation mix, with natural gas generating 73% of the province's electricity, 2% from hydroelectric, and wind and solar producing a combined 10% of electricity.
- There have also been improvements with water treatment resulting in less chemical and water use.
- Low water use air emissions controls have been implemented (e.g., dry, low NO_x setup on a gas turbine instead of water injection).

29 Statistics Canada. Table 36-10-0489-01. Labour statistics consistent with the System of National Accounts (SNA), by job category and industry.

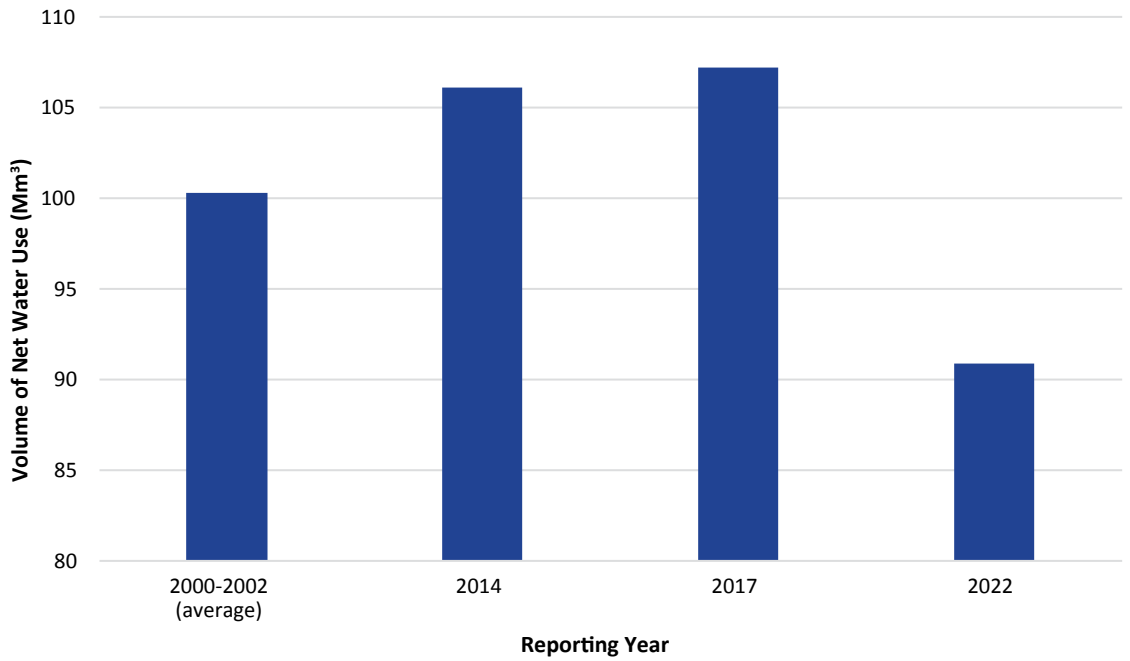

Figure 11. Power Generation Sector's net water use since the initial baseline year. Actual water use data is publicly limited; thus, the sector was unable to report water diversion and return flow.

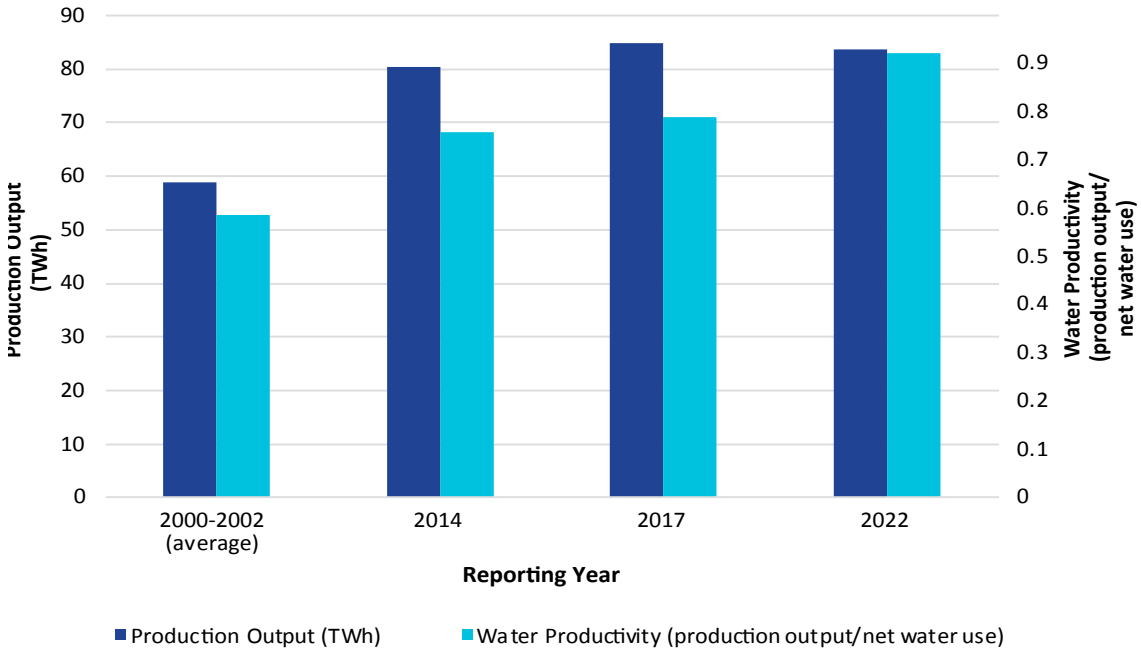

Figure 12. Power Generation Sector's production output and productivity since the initial baseline year.

2.6.2 Criteria for success

A key challenge for the Power Generation Sector in developing its plan was that actual water use data may be reported to regulatory agencies, but very limited information was publicly available at a unit or facility level. To overcome this barrier, the sector developed performance indicators to estimate water use for different fuels and generating technologies based on typical water consumption rates available from the Energy Technology Innovation Policy research group. Actual data for electricity production was obtained from the Alberta Utility Commission's Electricity database and Alberta Electricity System Operator's market statistics. This methodology allowed the Power Generation Sector to estimate net water use and water productivity for all its sub-sectors. Performance indicators to estimate total water diversion and return flow was not undertaken and would require further assessment.

2.6.3 Implementation and reporting considerations

Establishing performance indicators to estimate water consumption has been an important part of the Power Generation Sector's CEP work. Continuing to improve the availability of water use reporting data for all types of power generation would allow for greater accuracy in the sector's CEP planning and reporting. The water use factors used to estimate consumption and productivity will need to evolve to consider changing operating characteristics and new emerging technologies anticipated to meet the challenges of climate change in the power generation sector. As power generation continues to transition to more renewable energy and natural gas, water demand by the sector is expected to decrease. External factors will also continue to influence water use in the Power Generation Sector, in particular:

- The magnitude, location, and timing of electricity demand affect power generation options and choices.
- Commodity prices and market dynamics influence the generation mix, and therefore water use.
- Regulatory policy at both the provincial and federal levels to reduce air emissions and GHGs may affect water use, as emissions reductions drive new technology choices.

2.6.4 Additional sector context

Power generation involves the type of technology that is used to generate electricity and includes: coal, natural gas (simple cycle, combined cycle, and co-generation), biomass, hydroelectric, solar, and wind. Much of the water consumed by the sector is used primarily for cooling, which is often accompanied by evaporative losses. Other consumptive uses include water treatment and general usage in plant facilities.

2.6.5 *Sector contributions to the* Water for Life *goals*

The Power Generation Sector's contributions to the three *Water for Life* strategy goals are outlined below.

Safe, secure drinking water supplies:

- The quality of effluents is well within the water quality standards from the federal Fisheries Act, which contributes to maintaining healthy aquatic ecosystems.
- Stormwater management and low impact development contribute to the protection of water sources.

Healthy aquatic ecosystems:

- Similar to the goal of safe, secure drinking water, maintaining the quality of effluents contributes to healthy aquatic ecosystems.
- Reusing water within operations and using treated wastewater, cooling ponds, and less water-intensive technologies have contributed to reducing water diversions.
- Generation facilities contribute to local habitat improvement opportunities.

Reliable, quality water supplies for a sustainable economy:

- Electricity generation's shift to less water-intensive technologies allows less water to meet power generation needs.
- Co-benefits of generation facilities include the establishment of provincial parks and infrastructure sharing (e.g., community water source management, irrigation).

2.7 Urban Municipalities

In Alberta, 85% of the population live in urban areas. Alberta Municipalities (ABmunis), formerly the Alberta Urban Municipalities Association (AUMA), first completed its sector CEP plan in 2009. The AUMA renewed its CEP plan in 2014 with a focus on improving water efficiency, and ABmunis is engaging municipalities across the province to renew it once again.

2.7.1 *Sector highlights and contributions*

The Urban Municipalities Sector chose 2017 as their baseline year and 2022 as their reporting year.[30] Highlights of this sector's CEP update include:

- 5% decrease in overall water use
- 8.3% decrease in residential water use
- 2% increase in unaccounted water loss

30 At the time of the sector's report, the latest available water use data from Statistics Canada was from 2019.

For the current reporting period, total per capita water use decreased by 5% and residential per capita water use decreased by 8.3% (Figure 15). These continued improvements in water efficiency for the sector can be attributed to the following conservation strategies:

- water metering, which is more widely used now than it was in the early 2000s
- public education campaigns (e.g., home leak detections)
- outdoor water restrictions (e.g., summer watering schedules)
- water loss audits (e.g., distribution system leak detection)
- fixture and landscaping rebates and promotions
- water reuse (e.g., industrial use of reclaimed water) and rainwater capture and reuse

Despite increased water efficiency over the reporting period, the sector has also experienced an increase in unaccounted for water, with losses from the distribution system being reported at 17% in 2019, compared to 15% in 2017.

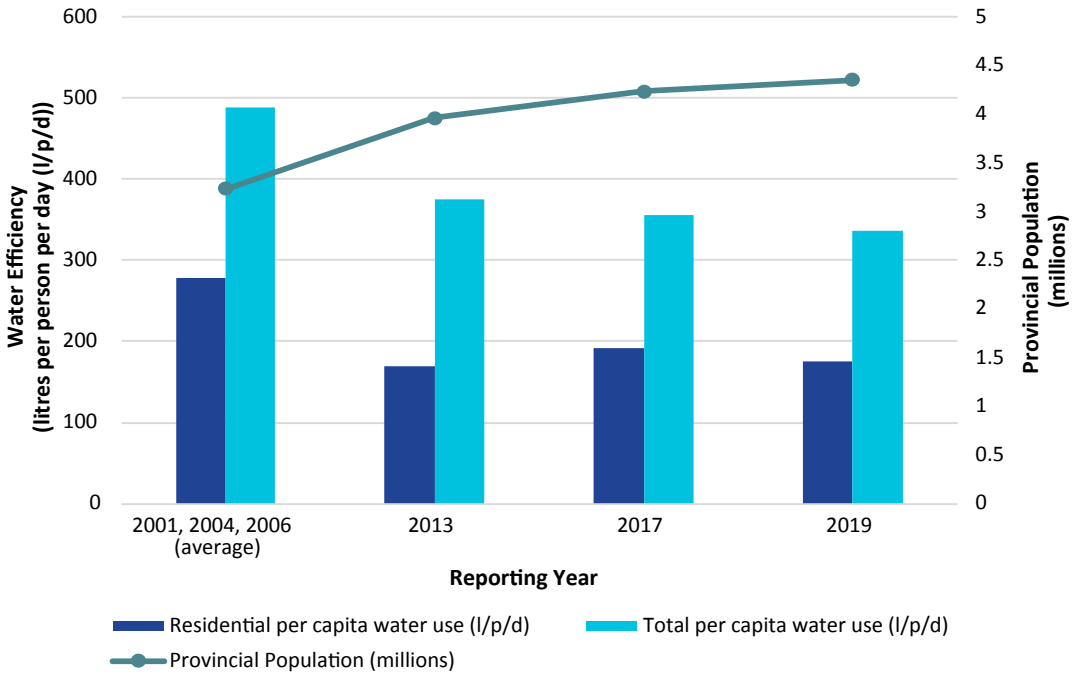

Figure 13. Urban Municipalities Sector's residential and total per capita water use since the initial baseline year. At the time of the sector update, the latest available data from Statistics Canada was from the year 2019.

2.7.2 *Criteria for success*

The sector's renewed CEP plan had two main targets around water efficiency and water losses:

- Achieve an average per capita residential water use of 195 litres/person/day (l/p/d) and a total per capita water use of 341 l/p/d by 2020 (both these targets are 30% below the baseline average).
- Maintain the volume of "unaccounted for" water at 10% of total water use (reported to be 10.1% in 2009).

2.7.3 *Implementation and reporting considerations*

The widespread adoption of water metering by municipalities in Alberta has provided municipalities with the information they need to have a more accurate account of how much water is in their system and how much is unaccounted for. There is an opportunity for municipalities to take advantage of advanced metering infrastructure to further investigate unaccounted for water losses. However, it is prudent to note that while diligent water loss management programs can yield reductions in unaccounted for water losses, striving for zero water loss is not realistic or economical. As the costs of further reducing water loss begin to outweigh the benefits, the incentive for additional mitigation diminishes. Given the challenges municipalities face, including increased regulations for water and wastewater treatment plants and limited funding for related infrastructure, water loss management strategies must remain pragmatic.

Recent circumstances allow municipalities to further explore opportunities in the realm of water reuse. In 2023, EPA changed legislation that reduced barriers to stormwater use. Previously, water diverted for use from a stormwater pond required a licence. However, the regulatory amendment now allows for stormwater to be diverted without an application under the *Water Act* in certain conditions.

2.7.4 *Additional sector context*

ABmunis relies on the federal government to collect accurate statistics on water usage for all municipalities. The sector obtains its water use data from Statistics Canada's Survey of Drinking Water Plants which is released every two years.[31, 32]

2.7.5 *Sector contributions to the* Water for Life *goals*

The Urban Municipalities Sector's contributions to the three *Water for Life* strategy goals are outlined below.

31 https://www150.statcan.gc.ca/n1/en/surveys/5149

32 The available data quality for Alberta was categorized as "Excellent."

Safe, secure drinking water supplies:

- Municipalities in Alberta are responsible for the delivery of potable water to residents under provincial regulations.
- Municipalities in Alberta are responsible for the treatment of wastewater and discharge into bodies of water under provincial regulations.
- Resolutions of ABmunis have been ratified by their members and form the basis for their advocacy on important issues.
- The *2020 Resolution: Sustainable Funding for Waste and Wastewater Infrastructure* advocates to the GoA and the Government of Canada to recognize the financial impacts of changing water regulations and asks for increased funding to municipalities as they meet provincial and federal regulations.

Healthy aquatic ecosystems:

- As indicated by the sector's improvements in water usage, water conservation continues to be an area of focus for municipalities.
- The maintenance of wastewater treatment infrastructure continues to be an area of focus for municipalities in Alberta. This infrastructure is critical to ensure all users and the environment downstream of any community are not negatively affected by human activity.

Reliable, quality water supplies for a sustainable economy:

- Residential water use accounts for 48% of all municipal water use. Thus, most water is used for non-residential and commercial use. Municipalities in Alberta produce and distribute some of the most reliable, quality potable water anywhere and is a key resource for the economy.

3. Conclusion

The AWC and its members, especially the organizations and municipalities that represent the seven major water-using sectors in Alberta, have played a significant role in improving CEP since 2007. The updates provided in this report outline the specific achievements, considerations, and unique challenges associated with developing and implementing diverse sector-level CEP plans over varying time frames, evolving regulatory conditions, and emerging priorities.

During this reporting period, several sectors maintained the progress or demonstrated improvements in CEP seen over various reporting periods. These include maintaining or improving on their success in meeting their sector-specific targets that contributed to achieving the initial *Water for Life* strategy's goals, including a target of a 30% improvement in efficiency and productivity of water use in Alberta by 2015, and CEP desired outcomes. Others saw a decline in their efficiency and productivity, though often demonstrated increased production during the current five-year reporting period and attributed the decline to sector-specific circumstances.

A direct comparison to the achievement of the initial 32% improvement from 2005–2015 compared to BAU was not possible. Some sources of data were unavailable, policies that affect water use by the sectors have changed since 2017, and other external factors affecting water use could not be captured in a BAU scenario. Several sectors also noted in their 2017 implementation update that many had achieved near the maximum level of CEP possible at the time, and any further gains in CEP were likely to be minimal and at a high capital cost. However, some noted continued research and development could potentially lead to further increases in CEP.

Alberta's major water users have demonstrated a willingness to remain adaptive and responsive to evolving challenges and opportunities in the realm of CEP. The AWC will continue to work with our members to maintain the momentum of improving CEP in Alberta.

Appendix A – Acknowledgements

The AWC acknowledges the contributions of the following CEP representatives who volunteered their time and expertise on this update, along with their member organizations for supporting their participation.

Name	Organization
Anna Kauffman	Alberta Forest Products Association
Dan Moore	Alberta Forest Products Association
Jim Hackett	Heartland Generation
Kai Horsfield	Chemistry Industry Association of Canada
Kris Samraj	Alberta Municipalities
Kylie Hill	Alberta Municipalities
Margo Jarvis Redelback	Alberta Irrigation Districts Association
Rob Hoffman	Canadian Fuels Association
Tara Payment	Canadian Association of Petroleum Producers

Project managers: Mariem Oloroso, Katie Duffett

Appendix B – Sector Report Template

AWC CEP Sector Updates – Sector Reports Template

In the 2017 final report *Looking Back: Evaluating Sector Improvements in Water Conservation, Efficiency and Productivity*, Recommendation 1 (page 6) states that:

> **Major water-using sectors collaborate with the Government of Alberta and other partners including the Alberta Water Council to continue reporting CEP trends and progress. Reporting will occur through the Alberta Water Council and at five-year intervals using the performance indicators and baseline data in Appendix C (ongoing).**

The 2023 CEP Sector Update will report on:

- Individual sector contributions and collective contributions to the 30% improvement target, CEP desired outcomes, and three *Water for Life* goals
- Successes and barriers in implementation and reporting of CEP opportunities

To ensure consistency in the reporting format between reporting periods and across all sectors for the update report, the following is the Sector Reports Template, modified from 2017. The information provided in each section will form the basis for reporting on each sector's individual contributions through CEP planning in our update report. Specific notes highlight areas where more detail would be useful.

The CEP desired outcomes noted were accepted by the first CEP project team as Recommendation 1 and are found in the 2007 final report *Water Conservation, Efficiency and Productivity: Principles, Definitions, Performance Measures and Environmental Indicators*.

1. Criteria for success

The evaluation recognizes that each sector had different targets (i.e., a sector has not failed because the 30% target was not met). Please provide details on your sector's individual criteria for success in CEP planning and implementation.

2. Sector contributions: 30% improvement target in efficiency and productivity

This section should define how efficiency and productivity are measured for your sector.

CEP desired outcomes 1 and 2 are closely related to the 30% target and should also be addressed in this section:

- *CEP desired outcome 1 – Demand for water is reduced*
- *CEP desired outcome 2 – Water use productivity is increased*

The table below serves as a guide to report on various numbers that may be relevant for your sector. Please note that given all sectors had different targets, not all sectors are expected to report on all numbers below, or you may choose to report in a different way. However, we hope to gather information on the ***licensed water volume*** *and* ***total water use*** *for all sectors for your baseline and reporting years.*

	Baseline year: 2017	**Reporting year: 2022***	**% improvement**
Water diversion (Mm^3)			
Return flow (Mm^3)			
Net use (diversion – return flow) (Mm^3)			
Water conservation			
Water efficiency (sector specific)			
Water productivity (sector specific)			
Productivity output (sector specific)			
Other relevant metrics (specify)			

*Your sector's reporting year may differ.

3. Sector contributions: *Water for Life* goals

5.1 If applicable to your sector and CEP plan, provide detail on the ways in which your sector works toward each of the *Water for Life* goals.

1) Safe, secure drinking water supplies

2) Healthy aquatic ecosystems

CEP desired outcomes 3 and 4 are closely related to healthy aquatic ecosystems and relevant contributions should also be addressed in this section:

- *CEP desired outcome 3 – Resources are conserved to maintain healthy aquatic ecosystems*
- *CEP desired outcome 4 – Water quality is maintained or enhanced*

3) Reliable, quality water supplies for a sustainable economy

4. Implementation and reporting successes and barriers

This section should highlight successes in the implementation and reporting of CEP opportunities, and any current or future barriers to implementation and reporting of these opportunities.

Appendix C – Summary of Data by Sector

The following tables provide a summary of data on each sector's water diversion, return flow, net use, and production output, where applicable, for the current reporting period.

Table 1. Summary of water diversion, return flow, net use, and production output data by sector during their respective baseline years

	Chemical	Downstream Petroleum	Forestry	Irrigation	Oil and Gas	Power Generation	Urban Municipalities
Baseline year	2017	2017	2009	2005	2017	2000–2002 average	2017
Water diversion (Mm^3)	22.3	11.3	19.7	2,186	259.7	Not available*	Not available*
Return flow (Mm^3)	5.3	4.2	17.6	459	Not applicable*	Not available*	Not available*
Net use (Mm^3)	17.0	7.0	2.1	1,727	259.7	100.3	Not available*
Production output	Not available*	69.5 Mm^3/ day of crude throughput	1,039.9 average dried metric tonnes of pulp/day	0.488 million hectares	1.598 million barrels of oil equivalent	58.844 TWh	Population = 4,253,53033

Table 2. Summary of water diversion, return flow, net use, and production output data by sector during their respective reporting years

	Chemical	Downstream Petroleum	Forestry	Irrigation	Oil and Gas	Power Generation	Urban Municipalities
Reporting year	2022	2021	2020	2020	2022	2022	2022[34]
Water diversion (Mm^3)	25.0	14.9	22.1	1,972	262.4	Not available*	Not available*
Return flow (Mm^3)	5.6	4.5	20.3	369	Not applicable*	Not available*	Not available*
Net use (Mm^3)	19.4	10.4	1.8	1,602	262.4	90.9	Not available*
Production output	Not available*	76.8 Mm^3/ day of crude throughput	1,037.7 average dried metric tonnes of pulp/day	0.531 million hectares	1,969 million barrels of oil equivalent	83.768 TWh	Population = 4,376,860

*For more information on why these data were not available for a specific sector, refer to section 2 of the report.

33 https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1710000901

34 At the time of the update, the most recent data available from Statistics Canada was from 2019.

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