Canada's

VENTURES TO VALUE CHAINS

WATER TECHNOLOGY

JULY 2023

FORESIGHT CANADA

ACKNOWLEDGMENTS

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AQUA ACTION

IISD International Institute for Sustainable Development

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BC NET ZERO INNOVATION NETWORK

Foresight is Canada's cleantech accelerator.

We bring together innovators, industry, investors, government, and academia to address today's most urgent climate issues and support a global transition to a green economy.

ABOUT

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INTRODUCTION

CANADA HAS A WELL-ESTABLISHED ECOSYSTEM OF WATER TECHNOLOGY (WATER TECH)

With a strong track record of innovation – such as the development of ultraviolet (UV) disinfection and membrane filtration technology – and a wide network of organizations, research institutions, and supportive governments, Canada is recognized globally for our expertise in the water sector.

Despite Canada's leadership in this sector, our knowledge of the strengths, gaps, and areas of opportunity in the national water innovation ecosystem remains fragmented. The importance of water tech is rising as an effective solution and a method of reducing the emissions intensity of water and wastewater treatment processes as we increasingly feel the effects of climate change. Water tech is critical in the practical sense, but also has the potential to be positioned as a lucrative opportunity as climate change rises in priority among investment and impact portfolios. Understanding the landscape of water innovation in Canada while painting the whole picture of the water tech value chain is an important step toward growing both its market share and impact.

RATIONALE

VENTURES TO VALUE CHAINS

is a Foresight initiative that leverages data from technology companies and other key stakeholders to map and categorize strategically important industry value chains for Canada in the clean economy.

This initiative will result in a searchable database, which can be used as a tool to inform stakeholders on Canada's competitive strengths, ecosystem gaps, and areas of opportunity and growth. These insights can identify where targeted programming, research and development, or funding will bolster Canada's leadership and economic development as we transition to a net zero economy.

WATER TECH: THE VALUE CHAIN

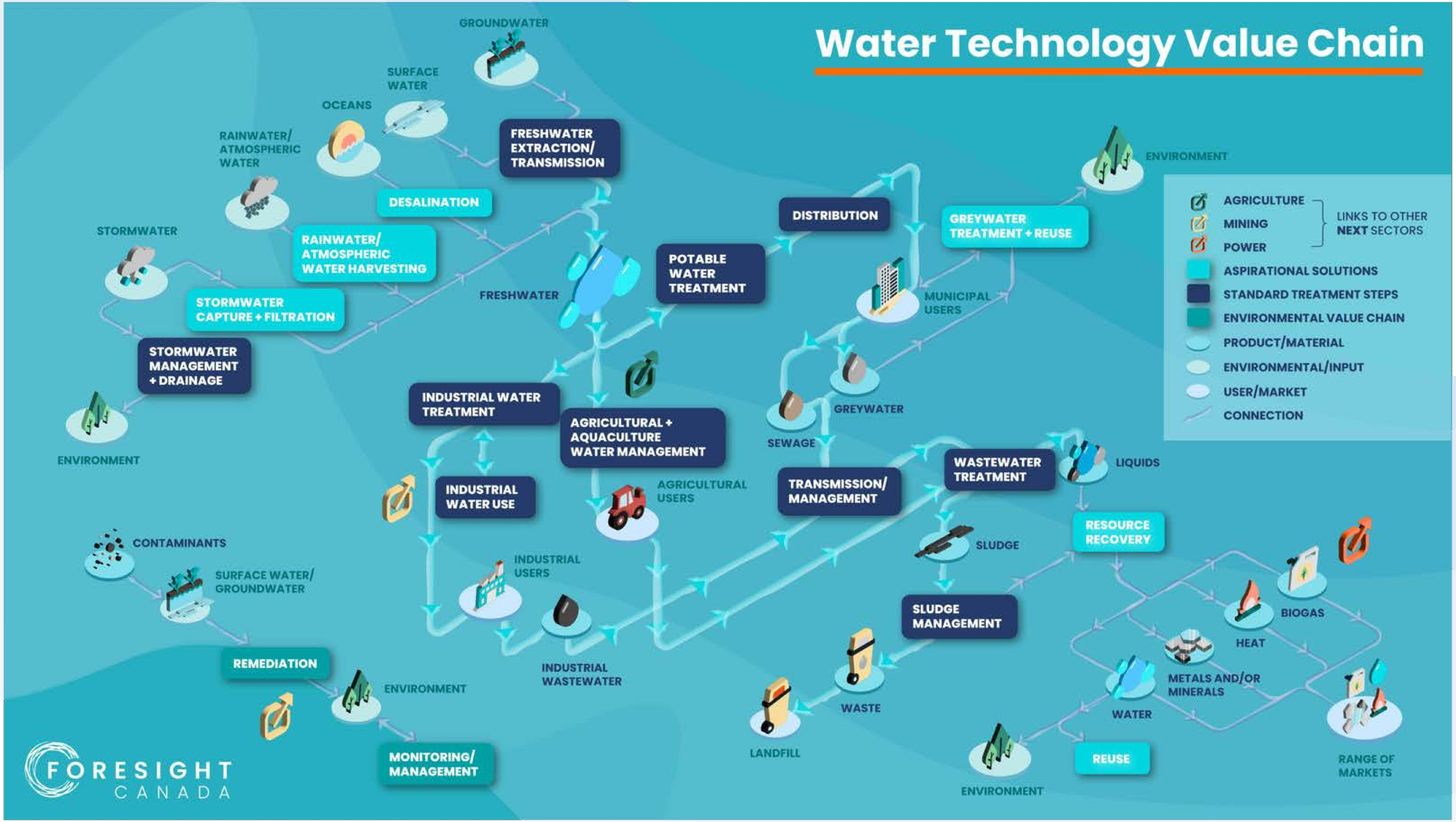


Figure 1

THE WATER TECH VALUE CHAIN (Figure 1)

describes the journey of water from source to outflow by identifying a series of processing steps and the ways in which they connect to inputs, outputs, and end points such as users, markets, or the environment [1].

THIS VALUE CHAIN WAS DEVELOPED TO BE FORWARD-LOOKING BY COMBINING THE STANDARD, MORE LINEAR WATER VALUE CHAIN THAT COVERS INPUT, TREATMENT, USE AND TRANSMISSION, AND OUTPUT WITH ONE THAT IS MORE ASPIRATIONAL AND CIRCULAR.

The circular steps such as resource recovery, water reuse (greywater and blackwater), stormwater capture and filtration, desalination, and rainwater and atmospheric water harvesting are currently limited.

Including these steps on the value chain is intended to represent an aspirational value chain that the water sector is working towards from an innovation and adoption standpoint as climate pressures grow.

The focus is primarily on freshwater that is collected, treated, and used by humans in industrial and municipal settings.

A secondary environmental value chain is also identified, focusing on environmental monitoring and technologies that remediate contaminated ground or surface water.

Because water is a sector that touches on many others, this value chain also identifies areas where there are overlaps with other sectoral value chains that Foresight is mapping. These are not intended to be an exhaustive list of sectors that overlap with water.

[1] While these are labelled as processing steps, they include both processing (e.g., treatment) and other types of actions within the value chain (e.g., use). For definitions of each of the processing steps, see Appendix A.

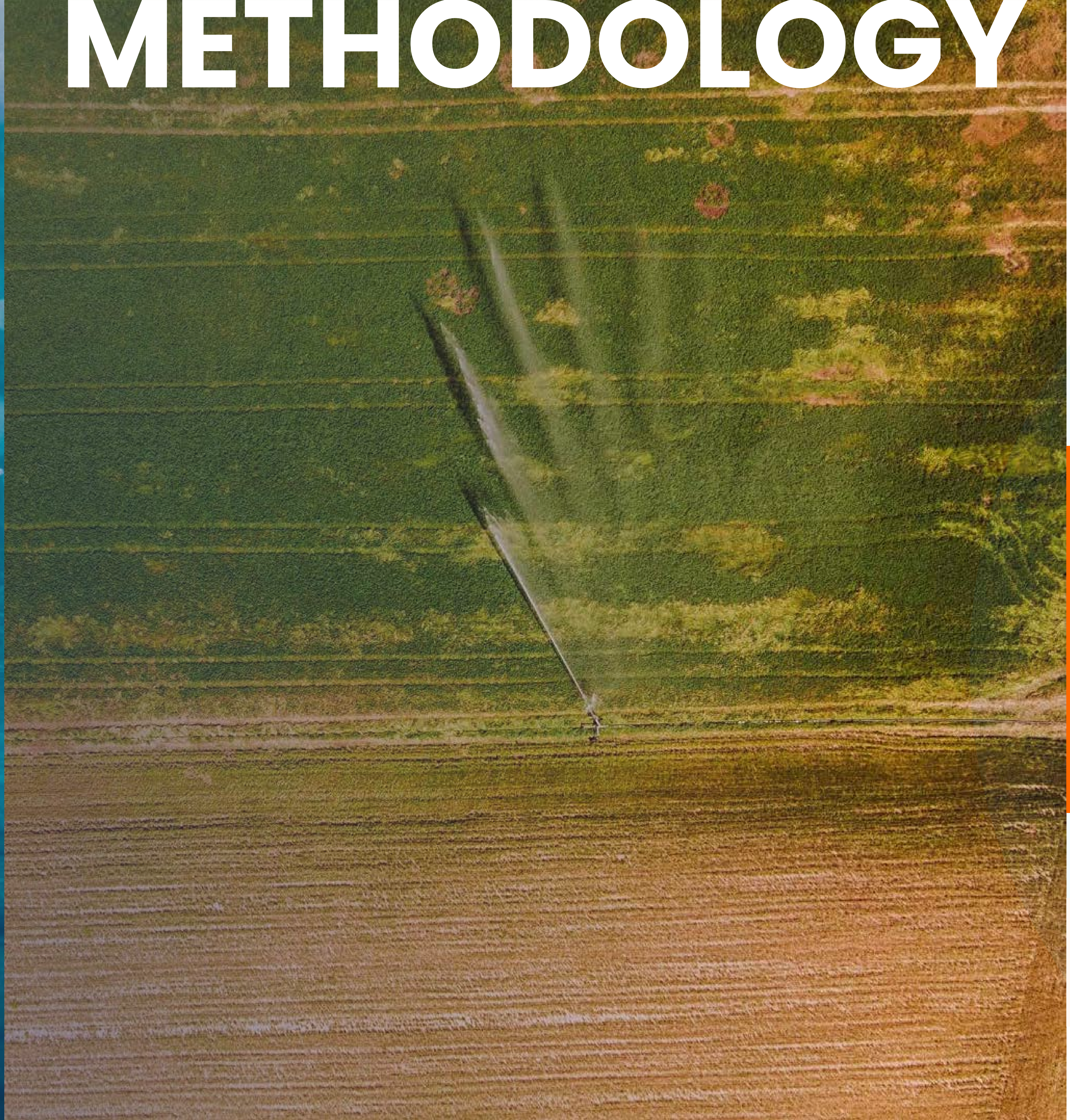
METHODOLOGY

This research was conducted by mapping the water tech ecosystem, categorizing companies based on the processing steps outlined in the value chain, and analyzing how the companies were distributed across the value chain.

The water ecosystem database comprises companies, enablers, and knowledge generators within the sectoral ecosystem. The value chain mapping and analysis focused on the companies, which were included based on the following criteria:

- Are involved in water tech innovation, research, and development in some capacity
- Are headquartered in Canada or have a strong Canadian presence in water tech innovation, research, and development
- Have either a direct link to water or directly support water-related industries

METHODOLOGY



Companies were categorized to up to three value chain steps based on their innovation focus, then analyzed to identify both provincial and national trends[1].

Keywords, functional categorizations, and secondary research were also used to provide additional context to the trends. Because the data can only indicate clustering and concentrations, and not why trends exist, observations are communicated as:

- **Areas of strength:** Areas where the data and supporting research suggests that the water tech sector is doing well and should continue to maintain.
- **Opportunities:** Areas where the data and supporting research suggests that there is an opportunity to grow, either because of minimal or uneven concentrations or because it is an area that can help meet the growing need for climate solutions.

For more detail on the methodology, see Appendix B.

[1] To better distinguish within categories, all companies were also classified based on the climate adaptation technology (CAT) framing and taxonomy, which is the intellectual property of Mazarine Ventures LLC, available to all under the Creative Commons (CC) license.

CANADA'S WATER TECH COMPANIES

From conveyance and distribution to treatment and reuse, Canadian solutions are also dramatically changing the way the world manages water and wastewater.

- Government of Canada Trade Commissioner Service [1]

Overall, the distribution of Canadian water tech companies across the value chain (Figure 2) represents a well-distributed, mature sector with large concentrations in the core activities associated with the traditional water value chain. While the more aspirational, circular steps are unsurprisingly less concentrated, they are all represented.

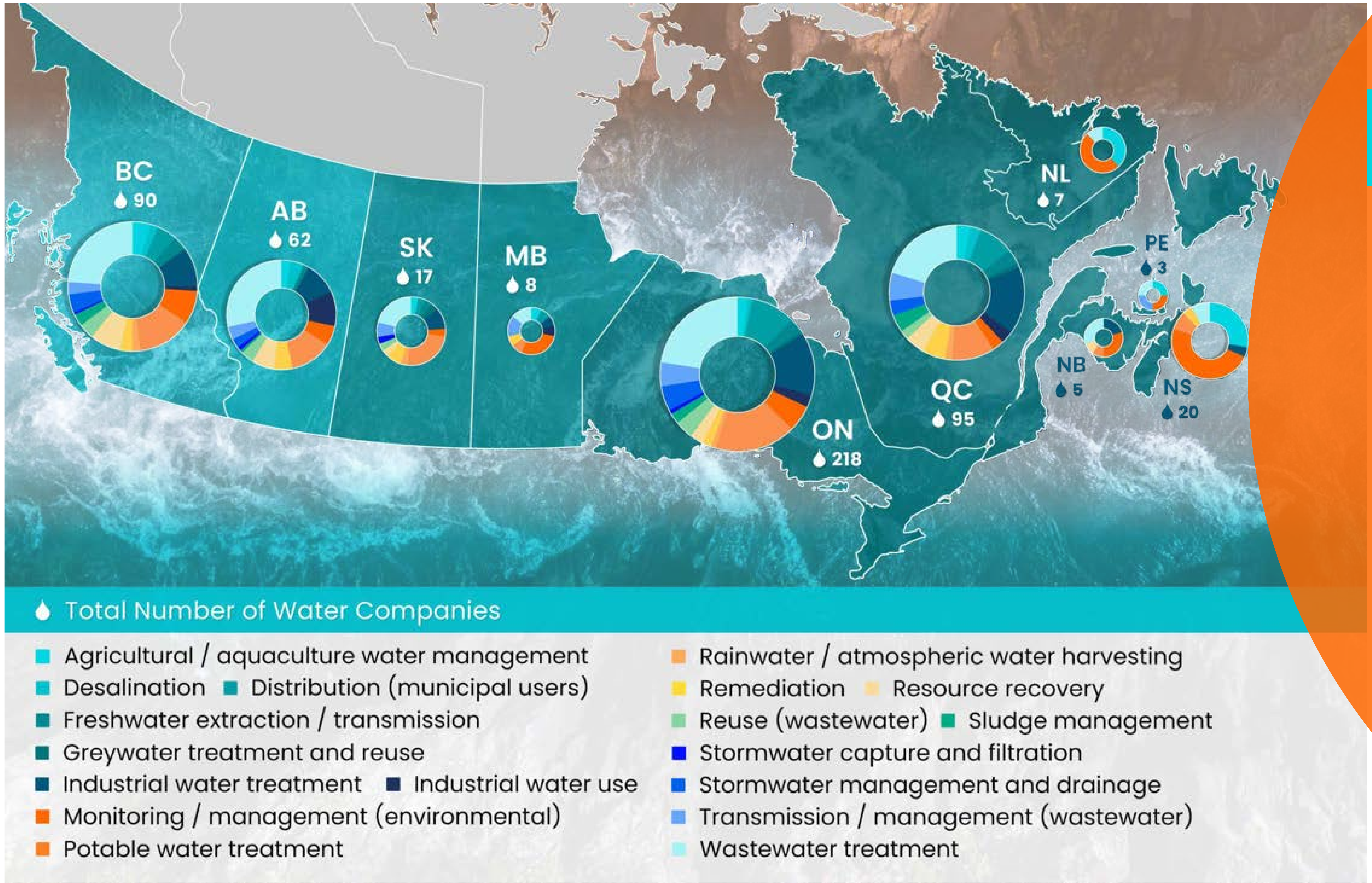


Figure 2

525

companies were assigned to the value chain, representing a large portion of

the over 2,000 Canadian cleantech companies

identified by Natural Resources Canada in 2022.[2]

Treatment represents the largest concentration of companies:

- **112** INDUSTRIAL
- **130** POTABLE
- **206** WASTEWATER

Of the more circular, aspirational categories, **resource recovery** (40) represents the largest concentration.

DEEP DIVE:
PROVINCIAL TRENDS

This section covers key takeaways based on areas of strength and clustering across the provinces.
Not every step is covered in every province, which is to be expected. Many of the companies, even if headquartered in one of the more densely populated provinces, serve other provinces and territories. Some value chain steps represent niche or emerging areas that will develop organically where there is a higher population or need.

WATER TECHNOLOGY VALUE CHAIN BY PROVINCE

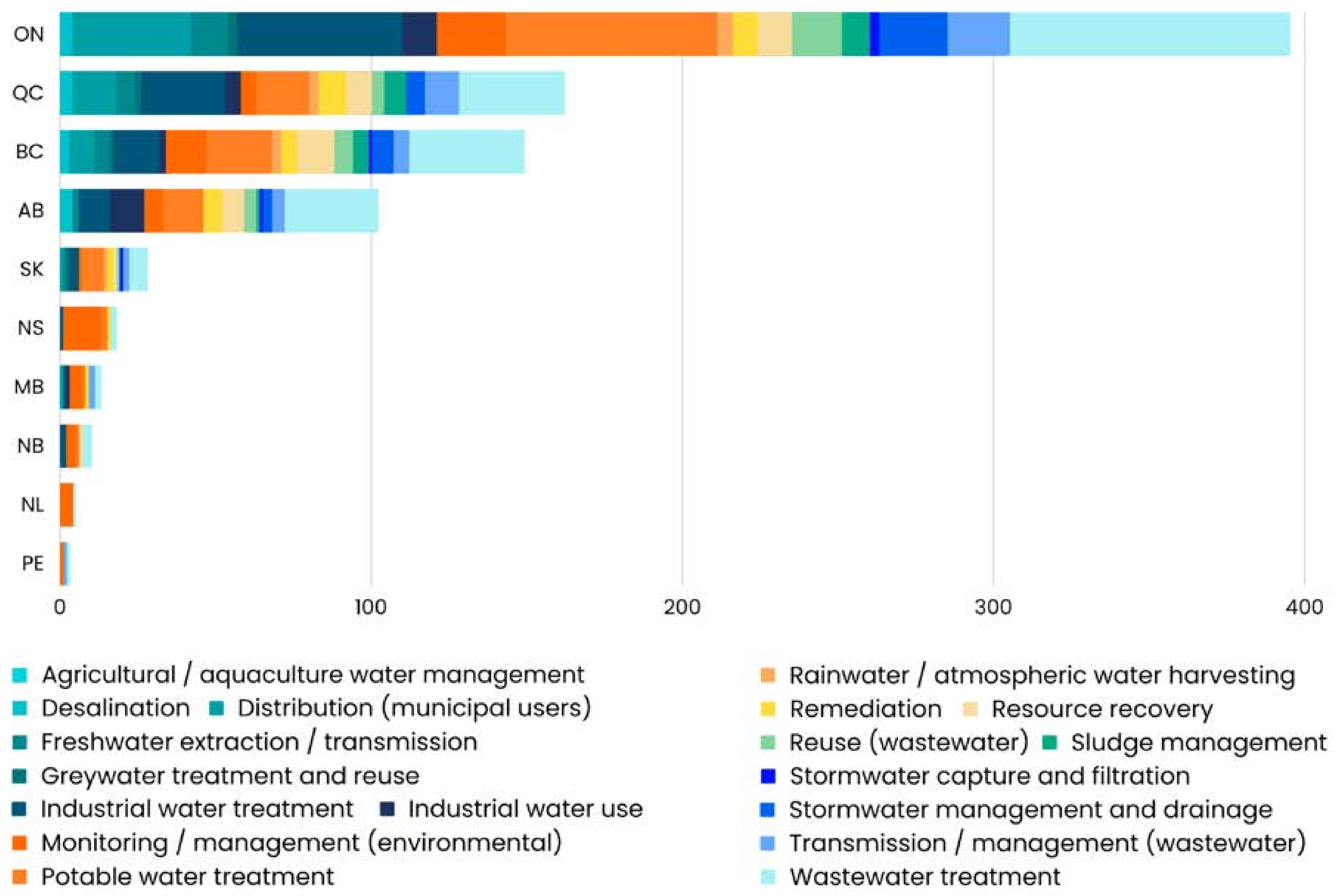


Figure 3

SUMMARY

- Wastewater treatment and monitoring / management (environmental) technologies are represented in all provinces
- The Atlantic provinces have some clear clustering in monitoring/ management (environmental)
- Water treatment and stormwater management and drainage are areas of strength for Ontario
- Industrial water use is an area of strength in Alberta
- Resource recovery is an area of strength for British Columbia

WATER VALUE CHAIN AS A FUNCTION OF POPULATION

(1,000,000 RESIDENTS)

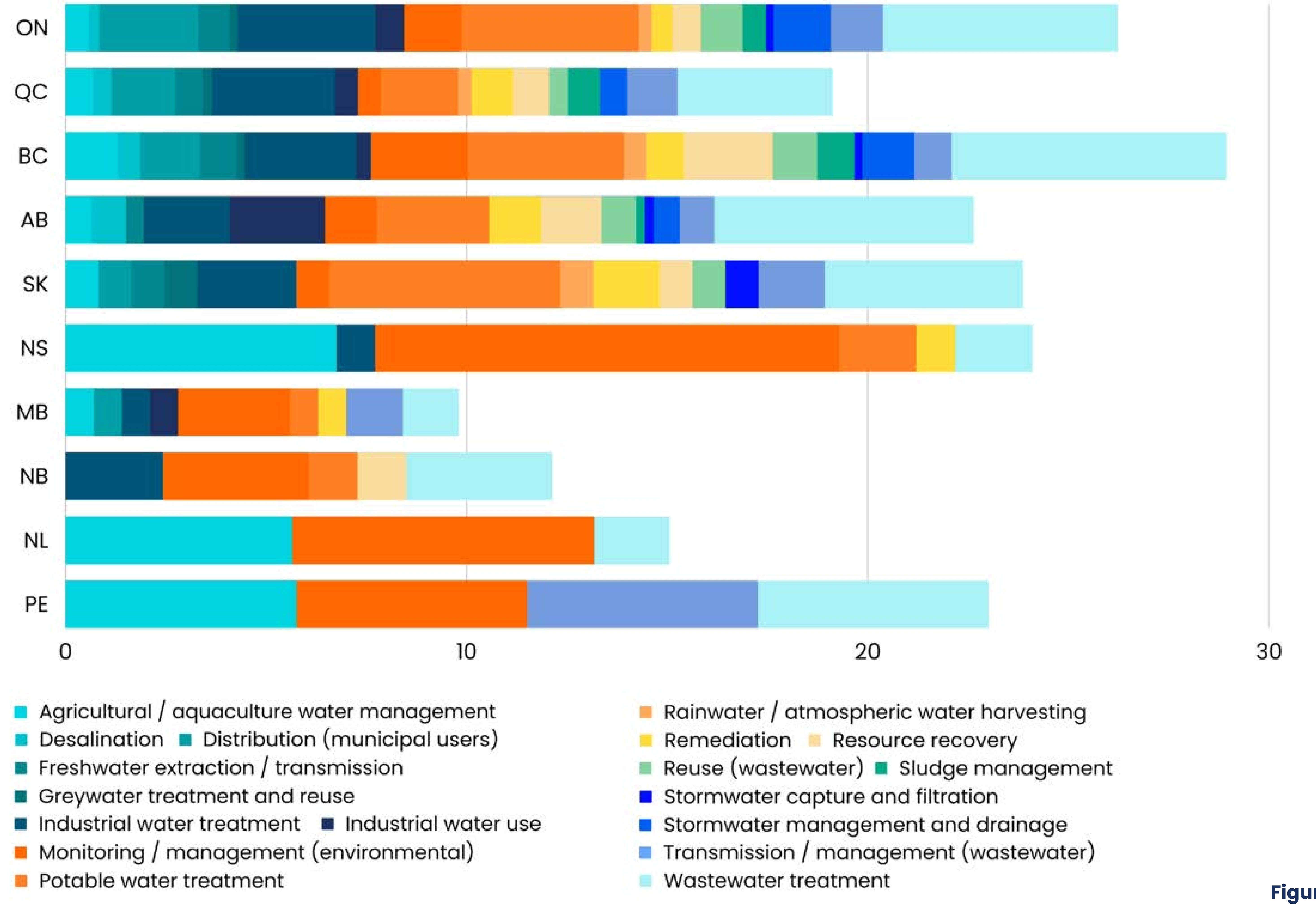


Figure 4

ATLANTIC PROVINCES

THE ATLANTIC PROVINCES (NL, NS, NB, AND PE) have clear clustering in monitoring/ management (environmental) and agricultural and aquaculture water management.

OBSERVATIONS

CLUSTERING IN MONITORING/MANAGEMENT (ENVIRONMENTAL)

CLUSTERING IN AGRICULTURAL/ AQUACULTURE WATER MANAGEMENT

SUPPORTING DATA

Monitoring/Management (Environmental):

- **20** companies
- NS, NL, PEI, and NB are the largest four by population
- NS is the third largest province by frequency (12)

Agricultural/Aquaculture Water Management:

- **11** companies
- NS, NL, and PEI are the largest there by population
- Companies with the “aquaculture” keyword represent nearly half (5/11)

DISCUSSION

The Atlantic provinces (especially Nova Scotia and New Brunswick) have high concentrations of both federal and provincial water monitoring sites. [3]

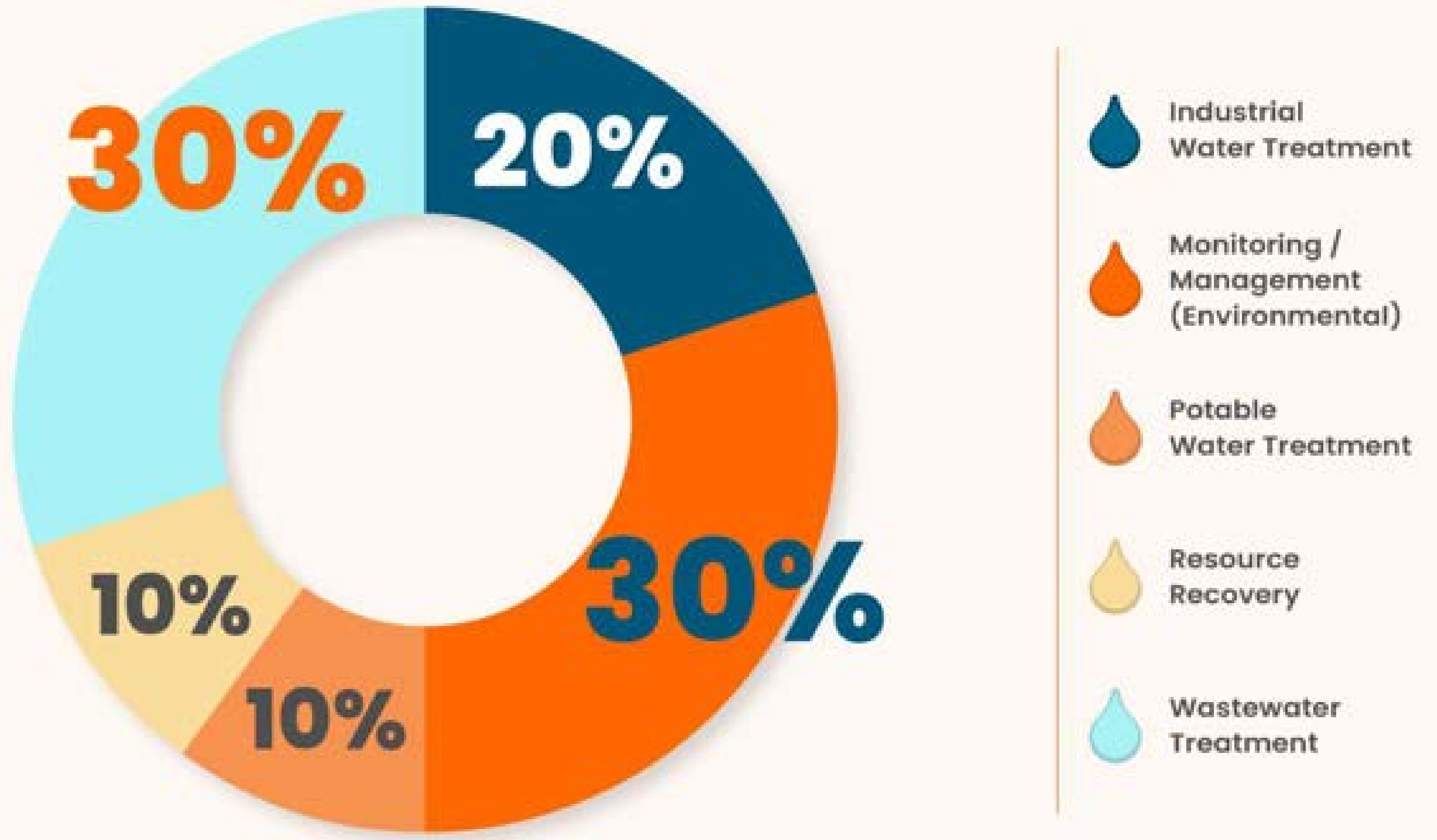
Many of these technologies have an ocean focus with secondary freshwater applications. This clustering could also be reflective of the Ocean Supercluster in Atlantic Canada. [4]

This clustering reflects how, while they are small compared to other more populated regions, these sectors are diverse and prominent in Atlantic Canada.

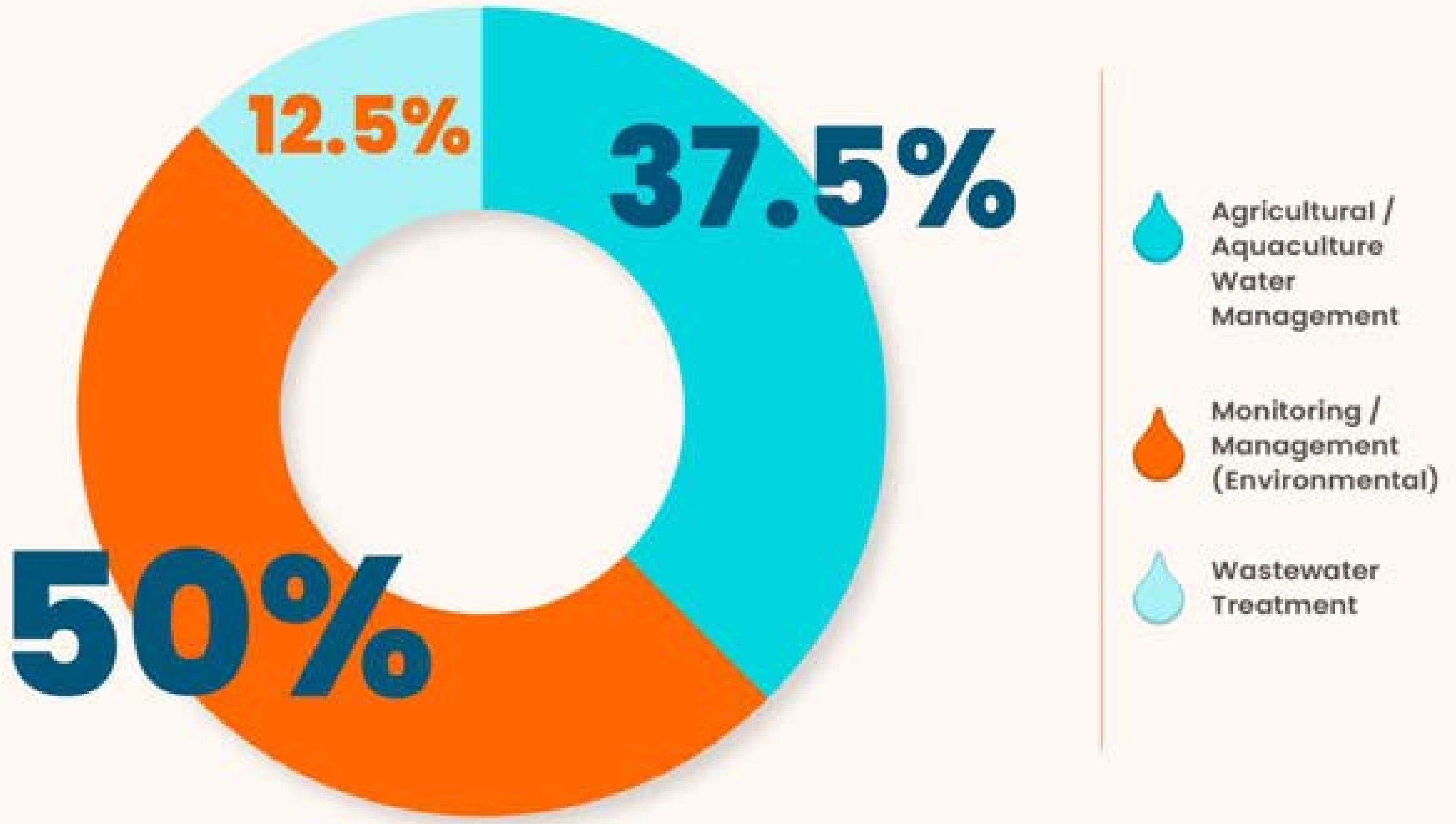
While agriculture is still the larger subsector, aquaculture production is expanding and agriculture production is declining. [5] This growth and the already prominent fisheries sector could be contributing to the large proportion of aquaculture companies.

ATLANTIC PROVINCES

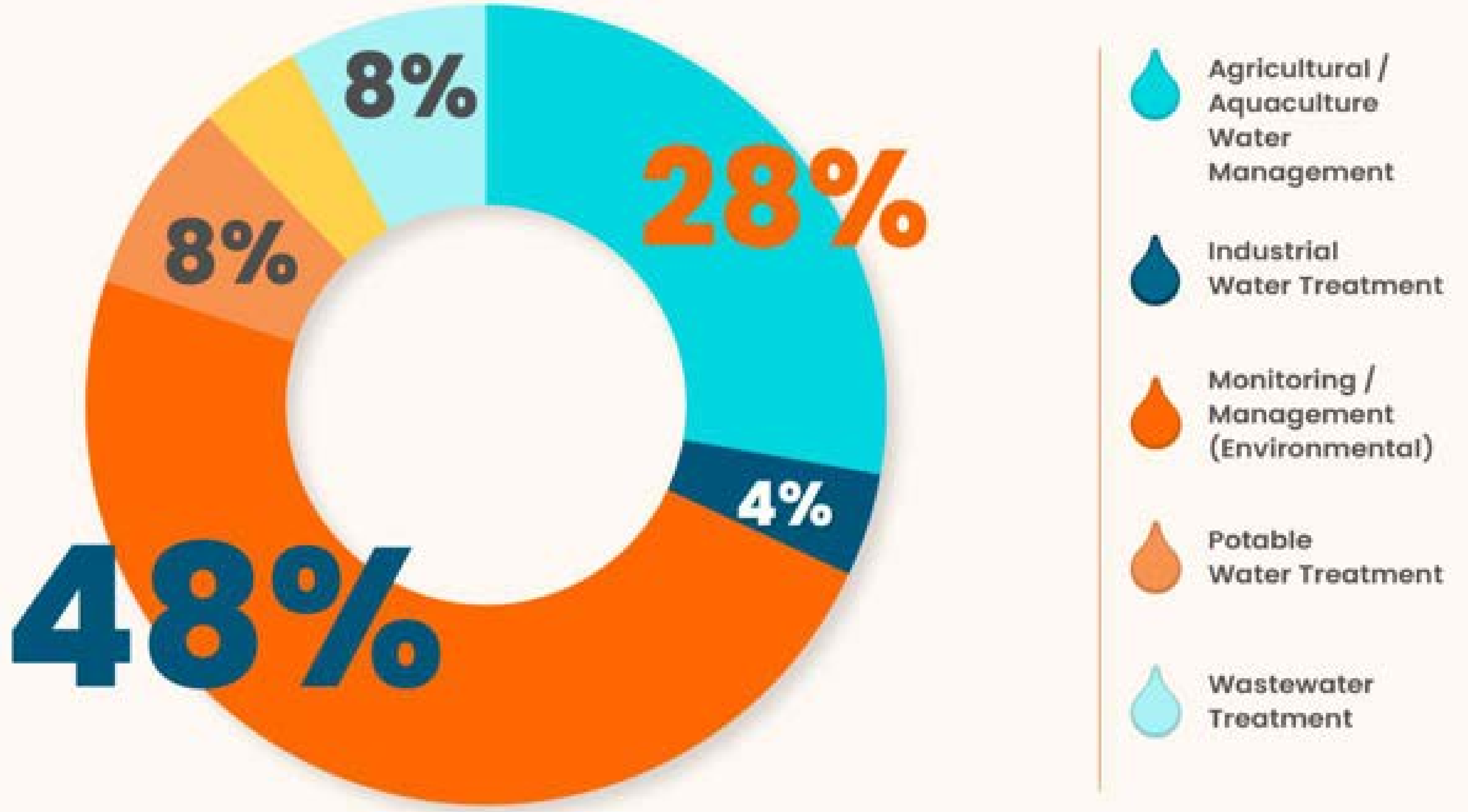
NEW BRUNSWICK



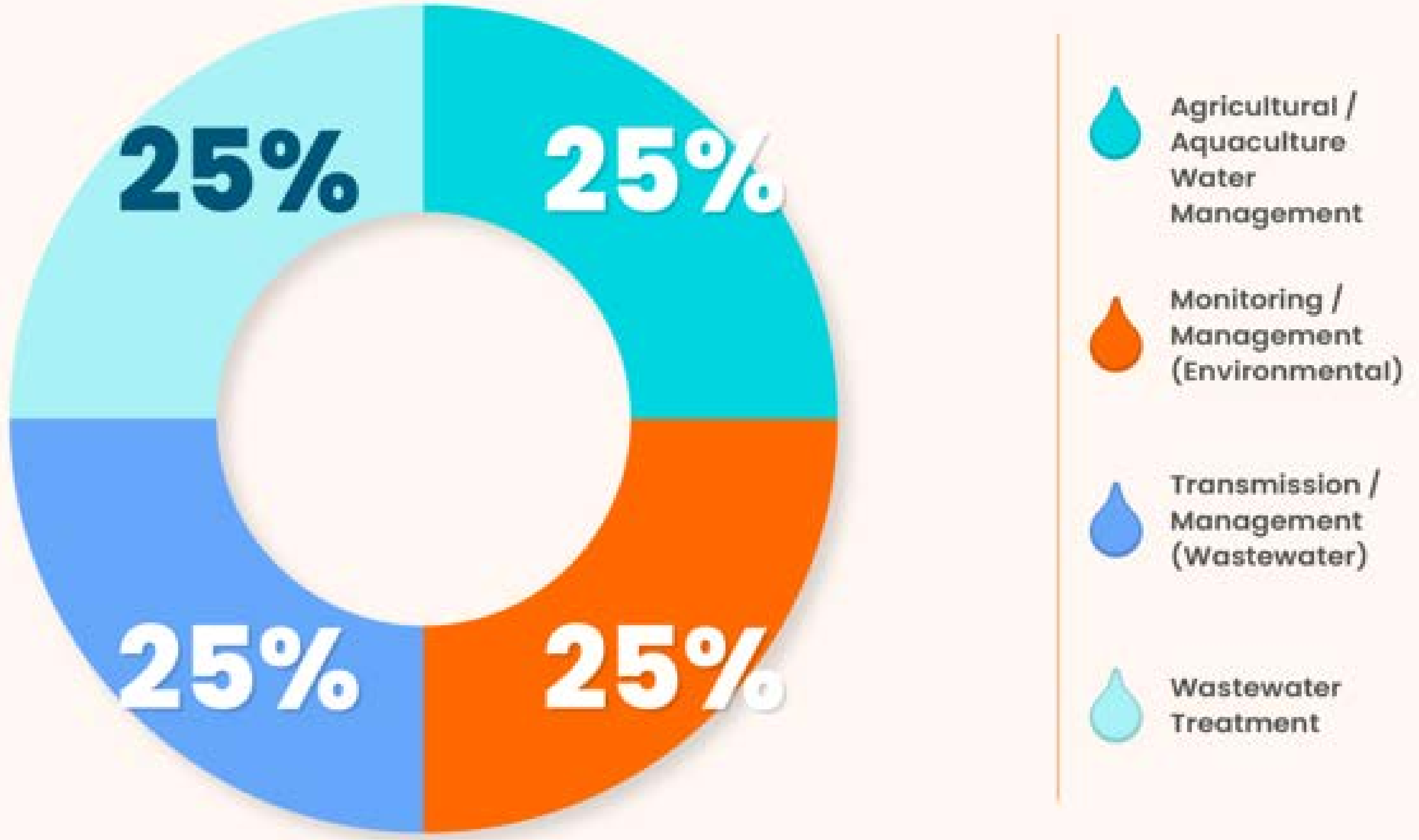
NEWFOUNDLAND



NOVA SCOTIA



PRINCE EDWARD ISLAND



QUEBEC

3%

OF THE WORLD'S FRESHWATER RESOURCES ARE IN QUÉBEC[6]

It is therefore not surprising that Québec has a mature water sector and well-distributed concentrations across the value chain. Québec's prominent industrial sector is well represented across the value chain, and there is some clustering in heat recovery technologies.

> **"As custodian of three per cent of the world's fresh water reserves, Québec must show international leadership in growth sectors."** [6]
>
> *- MDDELCC*

QUEBEC

OBSERVATION

INDUSTRIAL TECHNOLOGIES ARE WELL REPRESENTED OVERALL

CLUSTERING OF HEAT RECOVERY WITHIN RESOURCE RECOVERY CATEGORY

SUPPORTING DATA

- Industrial water treatment: **27** total companies and **3.1 per 1M** (second highest by frequency and by population)
- Nine remediation companies (highest by frequency)
- Industrial keywords (mining, manufacturing, industrial) in five out of the seven sludge management companies in QC

- **Five of the nine** total heat recovery companies are in QC

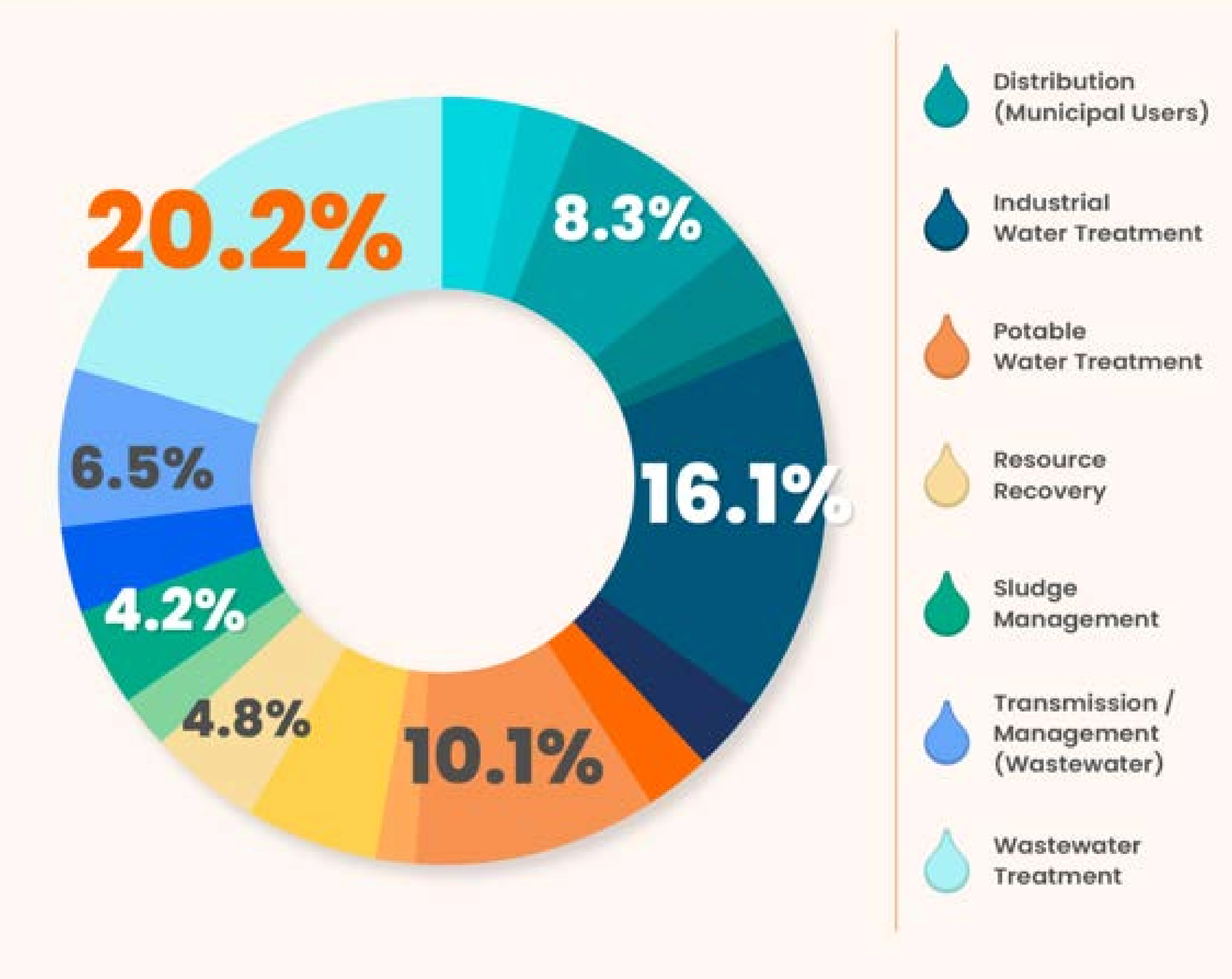
DISCUSSION

Québec's strong industrial presence and a progressive tightening of industrial waste regulations targeting the pulp and paper, mining, and manufacturing industries could have contributed to this focus. [7]

The 2018-2030 Québec Water Strategy also lists "advanced industrial expertise" as a factor that positions the province as a key player in innovation both within Canada and abroad when discussing the economic potential of water. [6]

These companies cover both heat recovery from residential drains and from waste heat.

VALUE CHAIN



ONTARIO HOLDS 20%

of the world's surface freshwater resources.

Combined with being the most densely populated province, it is not surprising that it has a mature water sector that is well distributed across the value chain. [8]

- Ontario has the highest frequency in all but two value chain categories and the highest by population in two.
- The most notable strengths are in the water treatment categories and stormwater management and drainage.

ONTARIO

OBSERVATIONS

WATER TREATMENT IS AN AREA OF STRENGTH

STORMWATER MANAGEMENT AND DRAINAGE IS AN AREA OF STRENGTH

SUPPORTING DATA

By frequency, significantly higher than other provinces:

- Wastewater treatment: **90 of 206** nationally
- Potable water treatment: **68 of 130** nationally
- Industrial water treatment: **53 of 112** nationally

Highest by population:

- Industrial water treatment by population: **3.4 per 1M**

- **22 of 38** nationally
- Highest by population: **1.4 per 1M**

DISCUSSION

These concentrations reflect Ontario's place as a global leader in water treatment technology, research, and innovation. Perhaps most notably, two treatment technologies, UV disinfection and membrane filtration, were both developed in Ontario. [9]

Ontario is prone to urban flooding, so it is not surprising that this has emerged as a strength, even though it is a small sector overall. However, with no formal updates to provincial guidelines in the last 20 years, local authorities have had to lead the way. [10]

Ontario-based programs like Sustainable Technologies Evaluation Program (STEP) are also focusing on green infrastructure. For example, the *Low Impact Development Stormwater Management Planning and Design Guide* evaluates the effectiveness of stormwater management technologies and design. [11] Several companies categorized here (e.g., DECAST, Next Level Stormwater Management) are innovating in this space.

VALUE CHAIN

PRAIRIES

UNLIKE OTHER REGIONS

such as Québec, Ontario, and British Columbia that have significant freshwater resources, the Prairies are at higher risk for water scarcity.[12] The trends in these regions therefore tend to focus more on efficiently meeting the needs of communities and industries.

- Manitoba and Saskatchewan have small water sectors, with eight and 17 companies assigned respectively. Saskatchewan has a potential area of strength in potable water treatment, especially in companies that serve smaller populations.

- As a more populated province, Alberta has a larger sector that is generally well distributed across the value chain. However, there is a strong industrial focus that shows up throughout it.

PRAIRIES

OBSERVATIONS

BY POPULATION, SASKATCHEWAN HAS THE HIGHEST NUMBER OF POTABLE WATER TREATMENT COMPANIES

INDUSTRIAL WATER USE IS AN AREA OF STRENGTH IN ALBERTA

SUPPORTING DATA

- Seven potable water treatment companies
- Potable water treatment by population: **5.8 per 1M**
- Three companies with primary focus on modular systems

- Highest by population: **2.4 per 1M**
- One of the highest by frequency: **11** companies
- Seven companies are tagged with keywords associated with the oil and gas and mining industries
- Three of the four companies assigned to water reuse focus on industrial reuse.

DISCUSSION

This clustering could relate to both the lower water resources in the Prairies and the high rural population in Saskatchewan.

Three of the companies focus primarily on modular solutions aimed at small populations. This suggests a potential area of strength, especially when considered alongside the Government of Saskatchewan's recent investment in clean drinking water for rural and First Nation communities.[13] A prominent mining sector with many remote mine sites also likely plays a role.

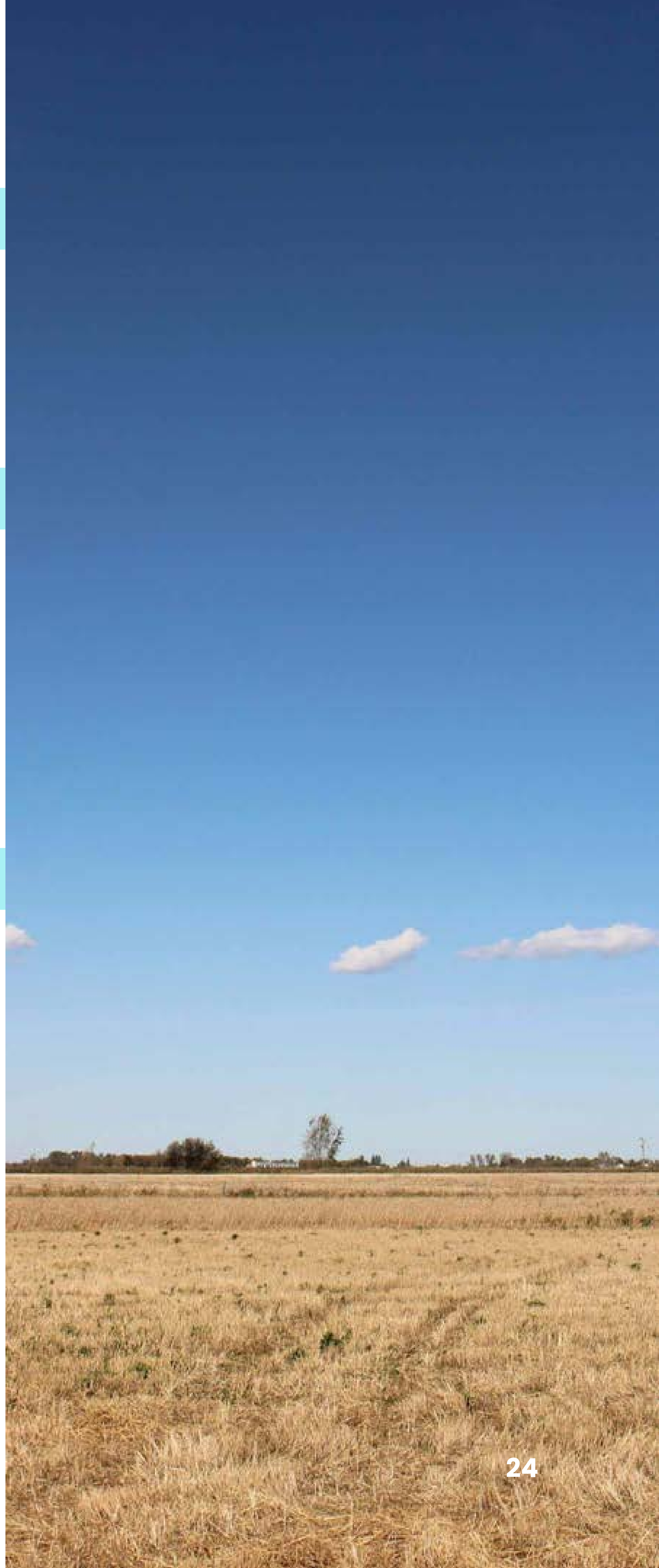
Further research would need to be done to identify if these concentrations are significant compared to other provinces.

This area of strength is consistent with the strong presence of the oil and gas industry in Alberta and the growing accountability placed on the energy industry to make more efficient use of water by bodies such as the Alberta Energy Regulator.[14]

It also reflects the recent growth in lithium mining as global demand for critical minerals and battery manufacturing increases. Alberta is well positioned to meet these growing needs due to the subsurface brine deposits at oil fields, previously considered industrial waste.[15]

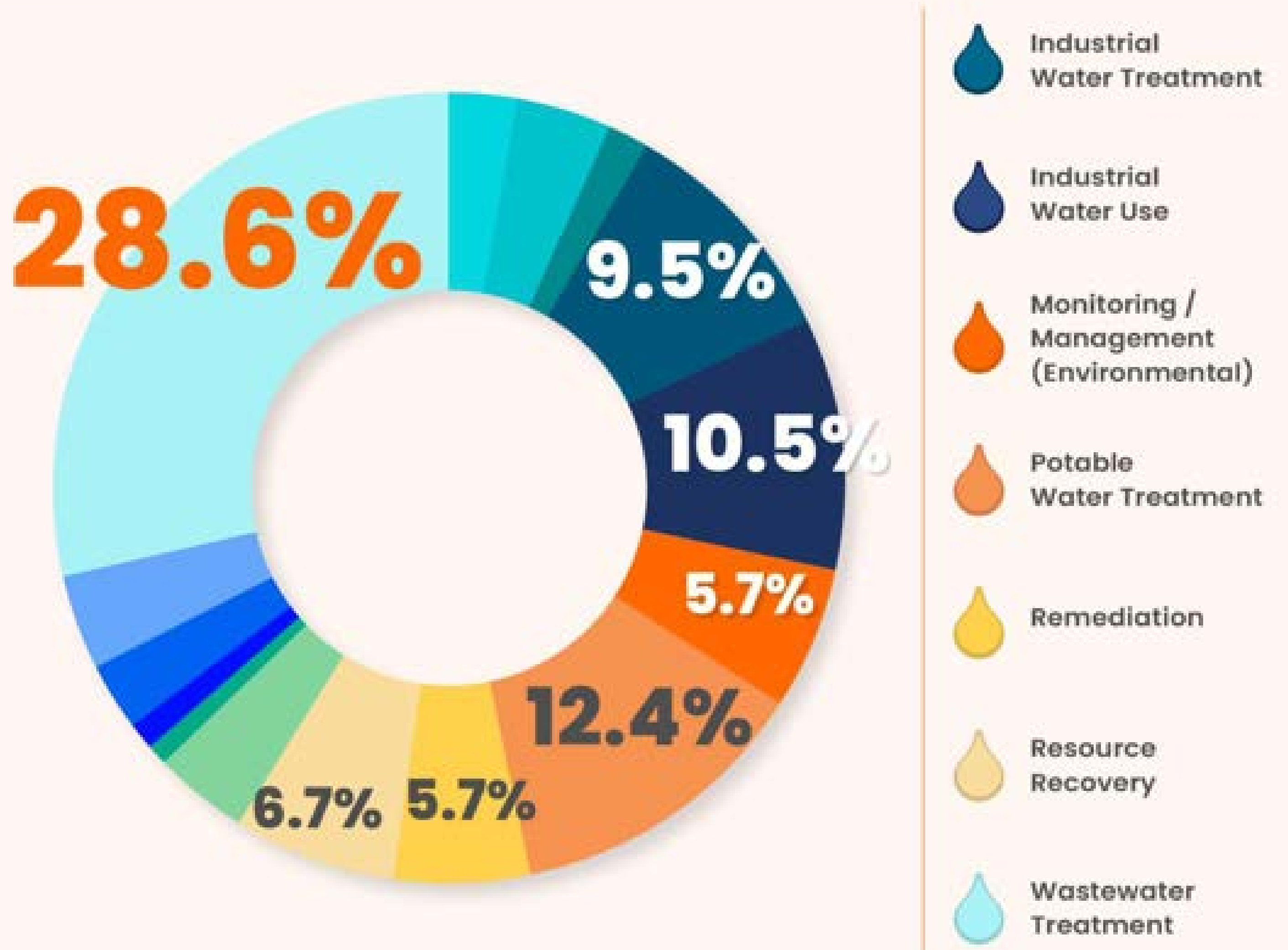
Many of the technologies focus on optimization in some way, whether that's monitoring to reduce water use or efficient processes (e.g., direct lithium extraction).

The prominence of industry in water reuse is also not surprising, since the energy and mining industries reuse over 80 per cent of their water.[14,16]

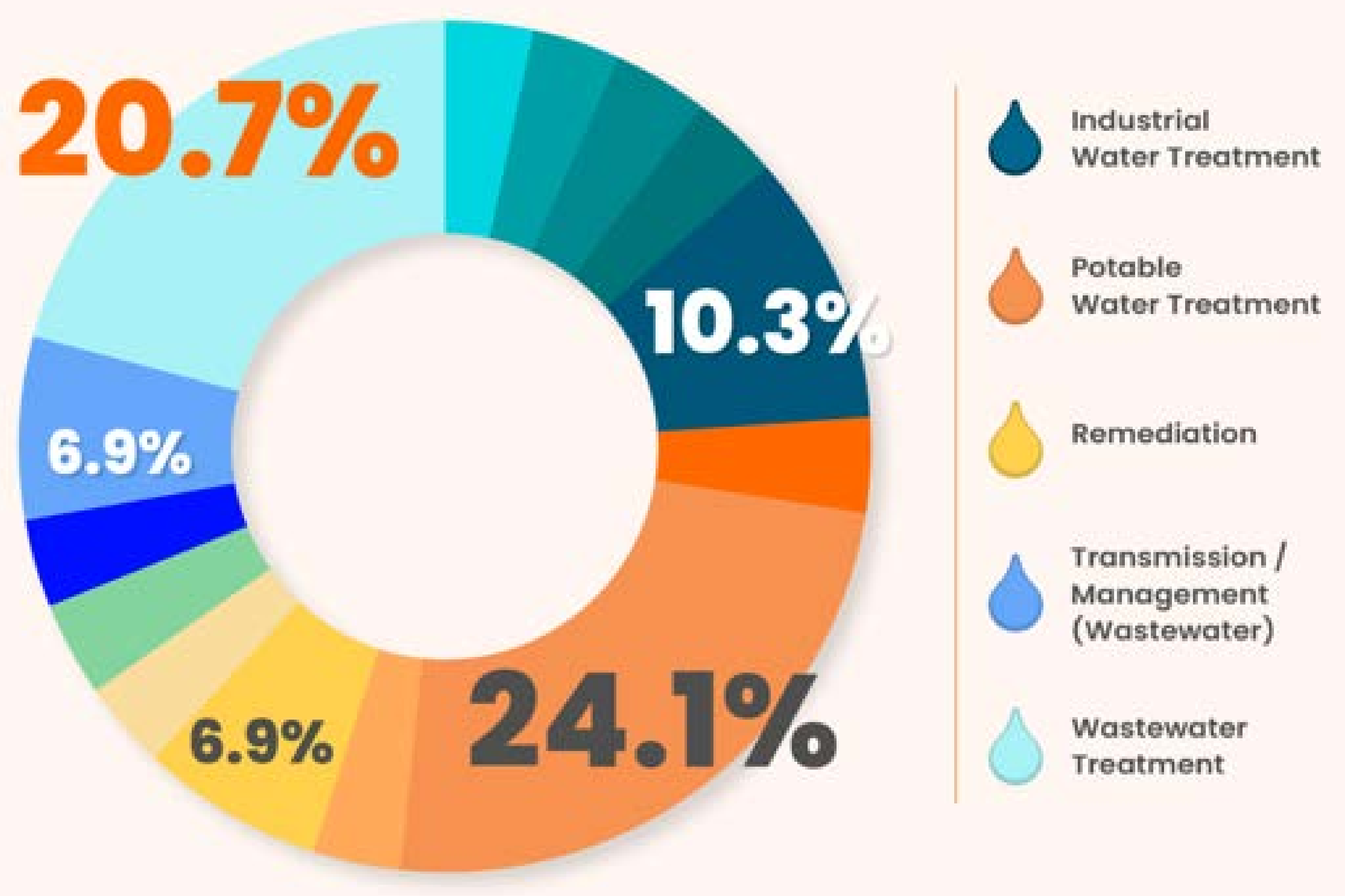


PRAIRIES

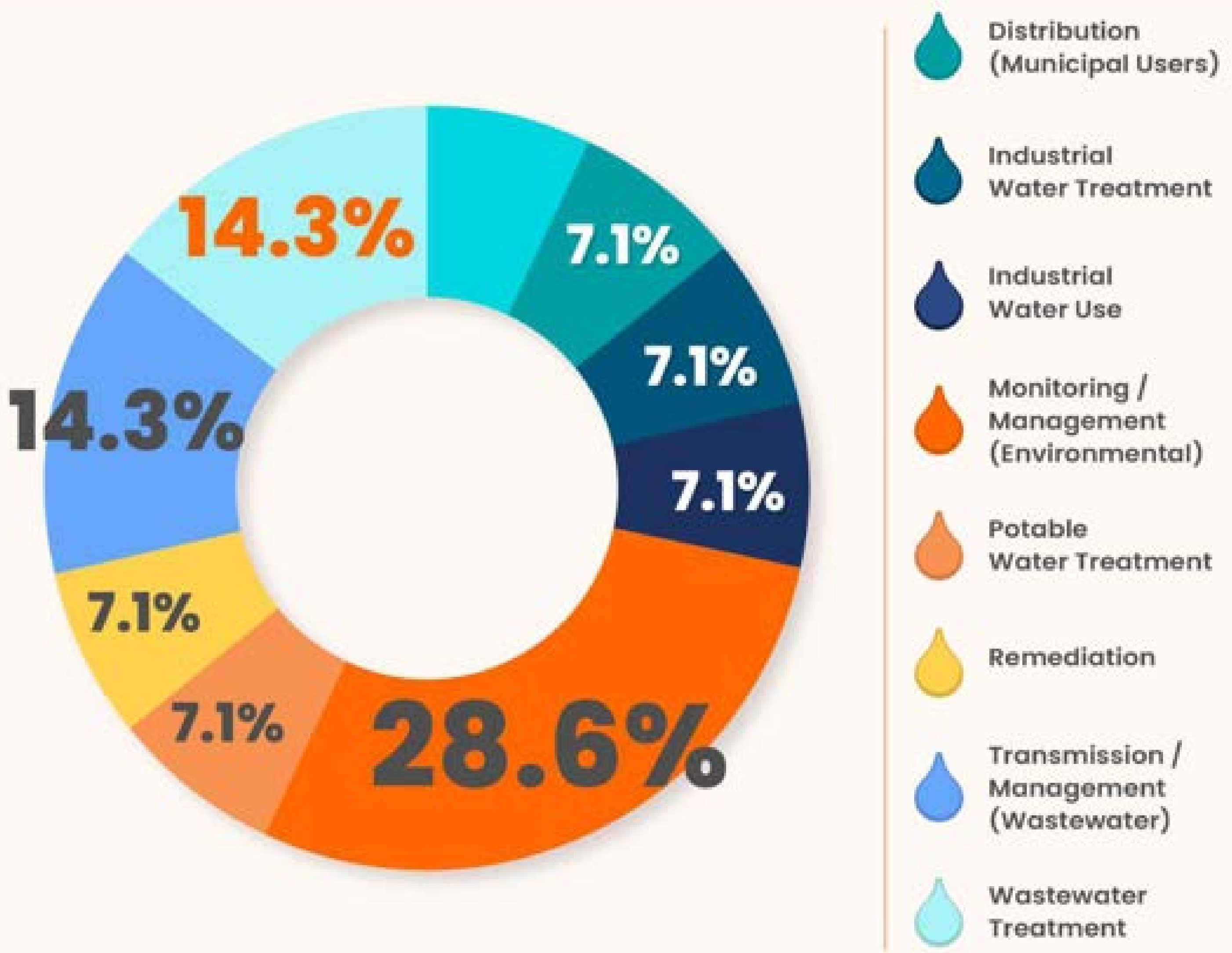
ALBERTA



SASKATCHEWAN



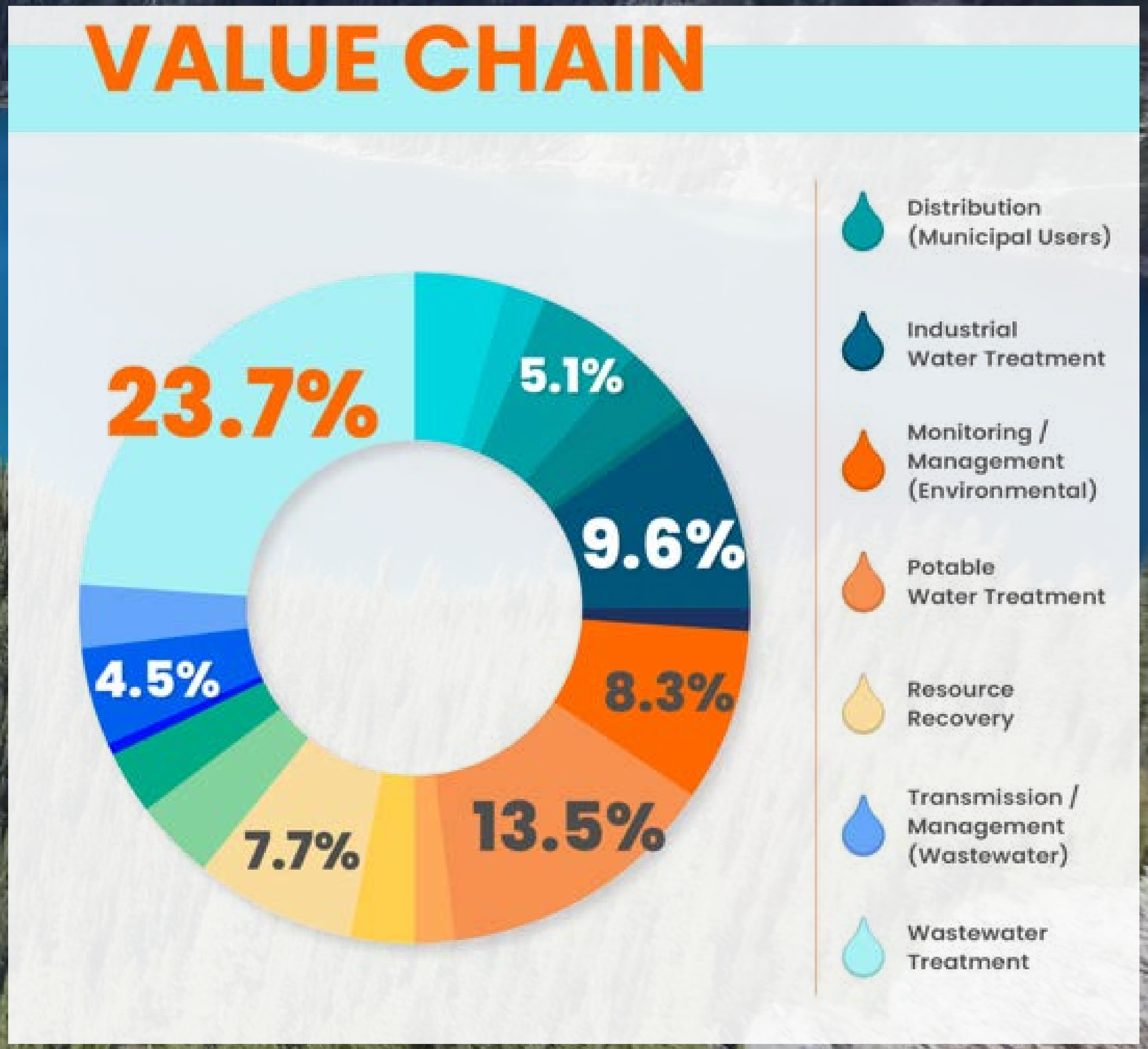
MANITOBA



BRITISH COLUMBIA

BRITISH COLUMBIA

holds the **third highest** quantity of freshwater reserves in the country. The province's well-distributed value chain has the highest numbers by population in five categories and the second highest by frequency in nine categories. The most prominent area of strength is in resource recovery.



BRITISH COLUMBIA

OBSERVATION

RESOURCE RECOVERY IS AN AREA OF STRENGTH

SUPPORTING DATA

- Highest by frequency: **12** of **40** companies nationally
- Highest by population: **2.2** per **1M**
- **Six** of the **12** total nutrient recovery companies are in BC
- **Five** of the **12** total metals/minerals recovery are in BC

DISCUSSION

The BC government's interest in supporting resource recovery initiatives isn't new. In 2009, they released *Resources to Waste: A Guide to Integrated Resource Recovery* to support local governments.[17]

Most companies are clustered around nutrient or metal/mineral recovery, likely due to BC's prominent mining sector, and the presence of agriculture.

Since resource recovery is an area of strength for BC in general, there could be opportunities to innovate in recovering other resources.

WATER TECH IN CANADA: A CLIMATE LENS

THIS SECTION OUTLINES IDENTIFIED AREAS OF STRENGTH + POTENTIAL OPPORTUNITIES FOR GROWTH IN CANADA’S WATER TECH SECTOR THROUGH THE LENS OF ADDRESSING CLIMATE RISK.

Canada's water and wastewater technology sector is well-established and recognized as a "long-standing cleantech industry" in Canada. [2]

Therefore, the core activities of the industry value chain such as water treatment and distribution and even some of the more circular ones like resource recovery are well covered.

Since the industry is mature and the foundational activities are generally well covered, the water tech sector is well positioned to become a leader in forward-looking innovation.

It is therefore important that policy, regulatory, or funding support for water tech in Canada is intentional.

In Foresight's *Climate and Water Toolkit*, we recommend that water tech companies "identify and articulate their climate value proposition as climate change increasingly drives public and private sector investment and impact priorities." [18]

Being intentional about support therefore may involve directing it toward developing or scaling technologies that address, observe, or analyze critical water issues that may become more prevalent as climate change progresses. This may include issues like the emissions intensity of water and wastewater treatment processes, infrastructure resiliency, flood mitigation, or water scarcity.

NATURAL RESOURCES CANADA'S 2022 CLEANTECH INDUSTRY SURVEY FOUND THAT WATER AND WASTEWATER FIRMS:

Have a high level of technological maturity:

61% of water and wastewater firms are in the commercialization and scale-up (TRL 9+) or exporting stages of development.

4% are in research and development. [2]

Aren't unified around a common challenge to growth:

- **Raising significant capital** was noted as the **biggest challenge** for all cleantech firms, including water and wastewater. However, responses for water and wastewater firms were not heavily biased toward any challenge. [2]

...water is both a climate risk and a critical resource for countries that are looking to boost their adaptive capacity. But water is often invisible in the climate conversation.

– UNFCCC [19]

WATER + CLIMATE: MITIGATION

Water treatment and transmission processes consume energy and emit greenhouse gases (GHGs).

Water tech companies can mitigate these effects by reducing energy use, reducing GHG emissions, and generating clean energy.

“Energy use by water and wastewater activities accounts for about 4% of the international electricity consumption and might double by 2040.”

– Environmental Commissioner of Ontario [20]

OBSERVATIONS

TREATMENT PROCESS ANALYTICS IS AN AREA OF STRENGTH

LEAK DETECTION AND PREVENTION AND INFRASTRUCTURE REHABILITATION IS AN AREA OF STRENGTH

INDUSTRIAL USE REDUCTION AND OPTIMIZATION IS AN AREA OF STRENGTH

SUPPORTING DATA

28 of **259** companies assigned to water treatment (industrial, potable, and wastewater) analyze the treatment process and associated facilities.

20 of **44** total companies that analyze and/or observe distribution (municipal) and/or transmission/management (wastewater) include keywords that suggest they focus on leak detection and infrastructure rehabilitation.

30 companies are assigned to the industrial water use category. Most of these focus on either optimizing or reducing water use in industrial settings, especially those that analyze and/or observe (11 companies).

12 of the **31** companies assigned to reuse (wastewater) have keywords that are related to industrial applications.

DISCUSSION

These companies include technologies that do data-driven analytics, modelling, forecasting, or automation to optimize the treatment process or better manage assets (filtered based on keywords).

These technologies can enable treatment facilities to make informed decision-making to **improve their energy efficiency.**

Nearly one in five kilometers of water, sewer and stormwater pipes in Canada were built before 1970.[21] Older systems can be prone to leaks or other inefficiencies. Early detection, prevention, and prompt rehabilitation of these inefficiencies:

- **Prevents water loss**
- **Prevents contamination** from wastewater infrastructure failures
- **Reduces energy use** in both treatment and transmission

Implementation of asset management plans among Canadian water infrastructure owners is growing, possibly due to greater availability of condition data. [21]

Industry (electric power generation excluded) accounts for 20.8 per cent of Canadian water use. This has been decreasing despite economic growth, which suggests efficiency improvements. [22] It is important for the industrial sector to continue to reduce and optimize water to **reduce overall energy use** and **GHG emissions**.

Industrial water reuse varies significantly by sector, depending on factors such as their water use intensity, effluent regulations, and social and environmental pressures. For example, the Canadian Oil and Gas industry is a leader in research and development in this space due to a combination of a high intensity of water use and societal pressures to reduce their environmental impact. [23]

OBSERVATIONS

HEAT RECOVERY IS AN OPPORTUNITY

BIOGAS RECOVERY IS AN OPPORTUNITY

RESIDENTIAL CIRCULAR WATER IS AN OPPORTUNITY

SUPPORTING DATA

Nine of the **40** resource recovery companies do heat recovery.

Seven focus primarily on residential applications.

Eight of the **40** resource recovery companies recover biogas.

See the Circular Water section for further discussion.

DISCUSSION

Residential drain water heat recovery (DWHR) systems can **reduce energy consumption** from water heaters by **25 per cent**. [24] Canada is a leader in this space:

- In 2013, Ontario was the first region in North America to mandate DWHR systems, followed by Manitoba in 2016. [25,26]
- DWHR incentive programs and rebates are offered in most provinces, typically through energy utility providers.
- Canadian manufacturers dominate the North American DWHR market. [27]

There are further opportunities to capture waste heat outside of residential settings:

Capturing energy from wastewater can **remove up to 54.7 million metric tonnes of GHGs** annually. [28]

Some energy utilities are leveraging waste heat from sewage pipes as a source of **renewable energy generation.**[29]

Recovering biogas from wastewater plants using anaerobic digestion can not only **divert GHGs** that would be emitted in the treatment process, but also **produce renewable natural gas (RNG).**

RNG has many potential applications. For example:

- Heating homes and businesses [30]
- Fuelling vehicles [31]

Modelling from the Canadian Biogas Association indicates that, with the right policy landscape, biogas and RNG could be a significant contributor to Canada meeting GHG reduction goals by 2050. However, there is still plenty of room to grow to meet this potential. [32]

Note on advanced wastewater and sludge treatments: Inefficient or poorly treated wastewater and sludge are major sources of GHG emissions. [33]

Advanced wastewater and sludge treatment technologies are present in the value chain (e.g., H2nano, Boost Environmental Systems).

However, further research is required to identify strengths or opportunities because these categories include a combination of traditional and advanced treatment methods and physical equipment and infrastructure.

WATER + CLIMATE: ADAPTATION

CLIMATE IMPACTS SUCH AS **EXTREME WEATHER AND ENVIRONMENTAL CONTAMINATION**

put stress on essential water infrastructure and increase water supply and quality risks.

WATER TECH SOLUTIONS can facilitate adaptation to these stresses by **monitoring and analyzing conditions** to provide decision support and by enabling **more resilient infrastructure.**

> …climate change poses a major challenge to water managers, users and policymakers at different levels, who must examine all potential and probable impact scenarios and interrelated issues, both within and amongst regions and sectors throughout planning and implementation processes.
>
> *– UNFCCC, 2014* [34]

OBSERVATIONS

TECHNOLOGIES THAT OBSERVE AND/OR ANALYZE IN ADAPTATION-RELATED AREAS ARE AN AREA OF STRENGTH

STORMWATER TECHNOLOGIES SUCH AS GREEN INFRASTRUCTURE THAT ADDRESS URBAN FLOOD RISK ARE AN OPPORTUNITY

WATER SUPPLY RISK IS LESS REPRESENTED IN THE VALUE CHAIN

SUPPORTING DATA

- **Environmental: 71** companies are assigned to monitoring/management (environmental)
- **Physical assets: 44** of **82** companies assigned to distribution (municipal) and/or transmission/ management (wastewater) observe and/or analyze.
- **Stormwater: 12** of **40** companies assigned to the stormwater categories (management and drainage and capture and filtration) observe and/or analyze

16 of the **28** companies that address stormwater management and drainage are tagged as water infrastructure and management, which includes both gray infrastructure and green infrastructure.

See the Circular Water section for further discussion.

DISCUSSION

Environmental, physical asset, and stormwater monitoring, analysis, and decision support technologies can help to prevent or mitigate **water quality** and **extreme weather** risks (e.g., pollution, urban flooding, ruptured pipes due to freeze thaw cycles).

Green infrastructure for managing stormwater is considered a best practice and key pathway for climate adaptation, particularly in mitigating urban **flood risk**. [35]

Efforts in this space are currently distributed and typically handled at the municipal level. For example:

- Vancouver's Rain City strategy [36]
- Green Infrastructure Climate Adaptation Project in Ontario [37]

This is currently a small sector, concentrated in Ontario (see Provincial Trends section). Broader, more coordinated funding and policy support could help to develop this sector.

CIRCULAR WATER

Circular water - alternative sourcing, water reuse, and resource recovery — is a space where Canada has a lot of opportunity to grow in a more coordinated way. While there are many water tech companies working in these spaces, there is greater activity at the output end of the value chain when compared to circular options as an input or in residential settings.

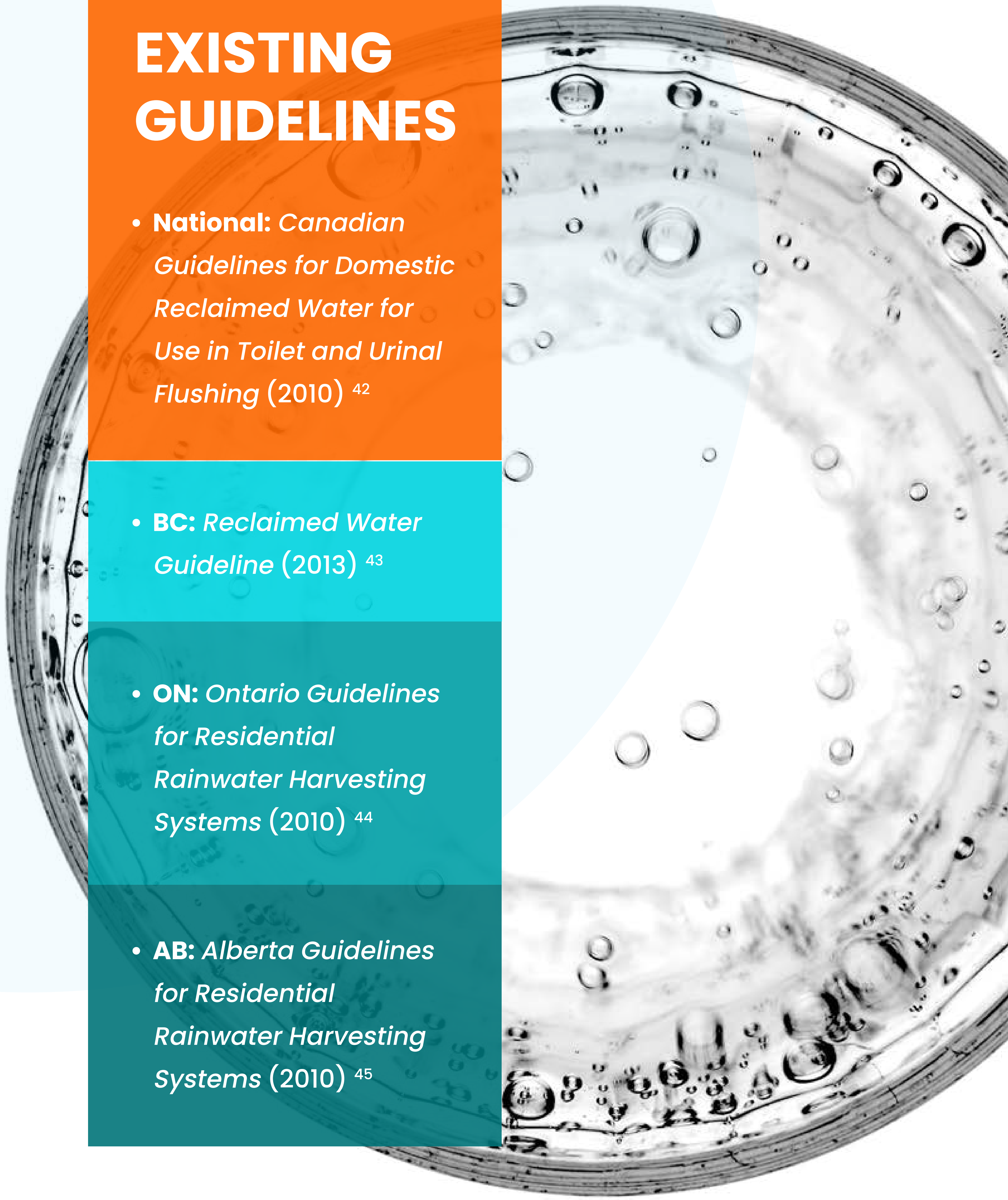
Several factors are contributing to Canada's uneven development in circular water technologies:

- **Canada has no history of prioritizing water conservation and water reuse through national policy.** Most regulations, policies, and projects are left up to the provincial and local authorities. [38,39] As a result, existing efforts are distributed and disjointed.
- **Innovation in water reuse typically relates to an immediate need.** For example, water reuse for irrigation in more arid regions (i.e., the Prairies) or in water-intensive industrial settings. [40]
- **Canada is water-rich.** However, some regions such as the Prairies are at high risk of water scarcity and drought. Even the regions that do have rich water supplies face many challenges such as industrial pressures depleting groundwater, toxic algae blooms, and lack of accessible drinking water for First Nation communities. [41]

Circular water is not only an opportunity to address water supply concerns, but also to **reduce greenhouse gas emissions** and **improve energy efficiency** in the treatment and transmission processes.

EXISTING GUIDELINES

- **National:** *Canadian Guidelines for Domestic Reclaimed Water for Use in Toilet and Urinal Flushing* (2010) [42]
- **BC:** *Reclaimed Water Guideline* (2013) [43]
- **ON:** *Ontario Guidelines for Residential Rainwater Harvesting Systems* (2010) [44]
- **AB:** *Alberta Guidelines for Residential Rainwater Harvesting Systems* (2010) [45]



OBSERVATIONS

CIRCULAR WATER IS LESS WELL REPRESENTED AS AN INPUT

RESIDENTIAL REUSE IS NOT HIGHLY REPRESENTED

MORE TECHNOLOGIES ARE ADDRESSING CIRCULAR WATER AT THE OUTPUT END [2]

SUPPORTING DATA

- **12** companies assigned to rainwater/atmospheric water harvesting
- **Six** companies assigned to stormwater capture and filtration
- **10** of **15** desalination companies are also assigned to industrial water treatment, industrial water use, or wastewater treatment

- **Seven** companies assigned to greywater treatment and reuse

- **31** companies assigned to reuse (wastewater)
- **40** companies assigned to resource recovery
- Specific resources recovered.[3]
  - Metals/minerals: **12**
  - Nutrient: **12**
  - Heat: **Nine**
  - Biogas: **Eight**
  - Other: **Four**

DISCUSSION

Diversifying water supply sources can be an opportunity to reduce:

- **Water supply risks** by conserving freshwater resources (e.g., increasing use of saline groundwater in Alberta for oil and gas recovery) [46]
- **Energy consumption** (e.g., rainwater harvesting versus wells) [47]
- **Pressures** placed on existing water and stormwater infrastructure

Since Canada is generally water-rich, it is not surprising that desalination companies do not reflect a strong focus on saltwater as an input beyond industry applications. However, there are opportunities to continue innovating in this space as climate pressures grow globally. [48]

Decentralized residential greywater reuse systems can have a significant impact in:

- Reducing municipal **wastewater** discharge
- Improving **water availability** for remote or water scarce locations
- Offsetting **water supply** and **energy** demands on municipal systems as cities expand [42]

Despite there being clear guidelines, concerns about municipal liability and public health have been a barrier preventing uptake, and more support from municipalities is required.[49]

Wastewater reuse and resource recovery can provide the following environmental benefits:

- Reduce **GHG emissions** and **energy use** from wastewater treatment processes
- Generate **renewable energy** and **heat**
- Reduce the need for intensive **extraction processes** (e.g., mining, extractive phosphorus recovery)
- Reduce environmental **water quality risks** (e.g., nitrogen and phosphorus overload in watersheds) [50]
- Reusing water for non-potable uses can **conserve** high-quality potable water [17]

Key challenges affecting growth in this area are the regulatory system and financial constraints [39]

[2] Companies assigned to the reuse (wastewater) and resource recovery categories had to have a clear focus on the recovery or reuse. Additional companies that treat water for various purposes including water and resource recovery would be covered by the wastewater treatment category.
[3] Some companies recover more than one resource

SMART WATER

The Swan Forum defines Smart Water as

"SOLUTIONS [THAT] IMPROVE THE USE OF A UTILITY'S PHYSICAL ASSETS BY BETTER MEASURING AND ACTING UPON NETWORK EVENTS."[51]

From a climate perspective, these technologies support adaptation and mitigation by **optimizing water management across the value chain.**

Smart water is a strong area in the Canadian water tech ecosystem, making up approximately 10–16 per cent of the database.[4] However, there is room to grow as the sector continues to adapt to climate risk.

[4] Since there was no quantitative way to determine the number of smart technologies, these percentages are estimated based on two approaches: companies tagged with "data and software" and "analyze" to identify a data analytics focus (60) and those with keywords reflecting data-driven technology (85).

"Digital technology can be a game-changer for businesses seeking to improve their environmental performance by reducing waste, energy, and water usage while increasing operational efficiency."

– BDC [52]

SMART WATER

OBSERVATIONS

PHYSICAL ASSET MONITORING AND ANALYSIS IS AN AREA OF STRENGTH

20 of **44** companies that analyze and/or observe distribution (municipal) and/or transmission and management (wastewater) include keywords that suggest they focus on physical infrastructure monitoring and analysis (e.g., leak, infrastructure, inspection).

SMART WATER TREATMENT MONITORING AND ANALYSIS IS AN AREA OF STRENGTH

30 of **259** water treatment companies (industrial, potable, and wastewater) that observe and/or analyze include keywords that reflect data-driven technology.

AI TECHNOLOGIES ARE NOT CLUSTERED GEOGRAPHICALLY

25 companies have an AI or machine learning keyword

- **Nine** in ON
- Remaining provinces have **three** or less

AGRICULTURE AND AQUACULTURE WATER MANAGEMENT HAS LARGEST CONCENTRATION OF AI COMPANIES

- **Nine** of the **25** companies with AI and machine learning keywords are assigned to agricultural and aquaculture water management
- **Four** have the aquaculture keyword

SUPPORTING DATA

(See data under each observation above.)

DISCUSSION

Monitoring and analyzing physical assets can prevent water quality risks and infrastructure failures and improve efficiency.

See further discussion in the Water and Climate (Mitigation) section.

Applying digital technologies to monitor and analyze the treatment process optimizes treatment steps and improves reliability. This, in turn, can help to **conserve energy**, reduce **GHG emissions**, and **reduce chemical use** [53]

There are established AI clusters in Montreal and Edmonton. [54,55] The lack of clustering suggests that these clusters might not focus on water tech, and could be potential opportunities there.

The Agrifood sector is prominent and well distributed across Canada and a significant water user. Common uses of AI include:

- In agriculture, optimizing water consumption and irrigation precision [56]
- In aquaculture, monitoring and enhancing water quality [57]

RECOMMENDATIONS

RECOMMENDATIONS

VENTURES, INVESTORS, GOVERNMENT, AND INDUSTRY CAN ALL BENEFIT FROM THIS DATA AND THE INSIGHTS IT MAY PROVIDE ABOUT THE SECTOR AS WE TRANSITION TO A NET ZERO ECONOMY.

VENTURES ARE RECOMMENDED TO USE THIS DATABASE TO GLEAN VALUABLE INSIGHTS ON GAPS AND OPPORTUNITIES WITHIN THE ECOSYSTEM TO:

- Identify innovation opportunities, potential partnerships, and competitors segmented both by geography and position in the value chain.
- Apply a broader understanding of where technologies fit on the value chain, and take stock of what other companies fit around them to better promote their existing strengths and make informed business decisions.

INVESTORS AND INDUSTRY WILL ALSO FIND THIS DATA TO BE AN INVALUABLE TOOL TO USE WHEN EVALUATING INVESTMENT OPPORTUNITIES IN ORDER TO:

- Understand the value add prospective ventures provide by identifying their role in the value chain.
- Determine what competitors might exist for any given company.
- Identify strengths, opportunities, and trends in the Canadian market to inform business decisions.

Industry end users can also use this data and the strengths and opportunities listed above to identify what and where their options are with respect to water technologies and to make informed technology adoption decisions.

ADDITIONALLY, GOVERNMENTS CAN CONSIDER THE KEY INSIGHTS DERIVED FROM THIS DATA TO IDENTIFY TARGETED AREAS FOR SUPPORT IN A MORE COORDINATED AND INTENTIONAL WAY.

KEY RECOMMENDATIONS FOR GOVERNMENT INCLUDE:

- Leverage and build on regional strengths and clusters to support a thriving innovation landscape. These strengths and clusters include monitoring tech in Atlantic Canada, industrial water in Alberta, resource recovery and circular economy in British Columbia, and the entire value chain in Ontario.
- Due to the increasing need to reduce the climate impact of water treatment processes, recognize and promote key technology areas of strength that mitigate emissions including treatment process analytics; leak detection, prevention, and infrastructure rehabilitation; and industrial water use reduction and optimization.
- Support the ongoing growth in monitoring technologies to be proactive about Canada's aging water infrastructure and adapt to water quality and extreme weather risks.
- Provide more coordinated support for technologies such as green stormwater infrastructure that address climate adaptation.
- Build upon circular water opportunities in a more coordinated way. For example, establish policy frameworks to enable clean energy generation from wastewater, support programming to empower residential users to adopt the circular water options available to them, and strategically consider circular water as an opportunity to diversify water supply.
- Build on existing strengths and support advancements in smart water technologies that can be used to improve efficiencies across the value chain.

CONCLUSION

THE BREADTH AND DEPTH OF THE CANADIAN WATER TECH ECOSYSTEM ACROSS THE VALUE CHAIN DEMONSTRATES THE SECTOR'S **STRONG TRACK RECORD OF INNOVATION AND EXPERTISE.**

There are, however, many opportunities to grow and lead, especially in the more forward-looking, circular steps.

NOW IS THE TIME TO TAKE IT TO THE NEXT LEVEL AND SEIZE THESE OPPORTUNITIES TO GROW INTENTIONALLY IN THE FACE OF INCREASING CLIMATE RISKS

Interested in learning more about Canada's water technology value chain?

FORESIGHT CANADA

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