

Minnesota's Water Industry Economic Profile:

Leveraging Industry Strengths to Grow an Emerging Cluster

September 2015

About this Report

Minnesota's Water Industry Economy Profile is the state's most comprehensive effort to quantify the businesses, employment, wages, patents and investments directly engaged in the water industry. In addition, this report assesses ways to support industry competitiveness.

This report focuses on four core water industry segments: water treatment, infrastructure & management, efficiency and utilities. This represents a subset of the "water-enabled" industry analyzed by other reports.

This research is to augment a more comprehensive review of Minnesota's water policies being compiled by Minnesota's Environmental Quality Board. The scope of this report is limited to assessing the size and characteristics of the water industry as identified above, and does not include a comprehensive economic analysis with data points such as the social cost of water or the cost of doing business.

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The Minnesota Environmental Quality Board and Minnesota's Department of Employment and Economic Development (DEED).



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EXECUTIVE SUMMARY

Safe and affordable water is an important part of economic vitality and public health. Unfortunately, water supplies are running perilously low around the world; by 2025, market analysts expect two-thirds of the world population will experience water stress.¹ This pending scarcity presents both a challenge and an opportunity for those companies that can provide efficiency and reuse solutions. Minnesota's combination of creative firms, progressive policies, supporting institutions and natural resources makes it well positioned to capitalize on this growing global demand.

Minnesota is home to the headquarters of several of the world's leading water industry companies as well as prominent complementary industries, such as agriculture and food manufacturing, that require clean, available water. Progressive policies have protected and afforded access to the state's 11,842 lakes and 6,564 rivers.² Excellent academic institutions provide Minnesota's water firms with fresh ideas and specialized talent. In addition, public and nonprofit entities are becoming the connective tissue that stitches the industry together.

This convergence of statewide assets is indicative of an emerging water "cluster." Clusters increase a region's competitiveness, drive innovation, produce tradable products and services, and create workforce opportunities. By growing Minnesota's water cluster, the state can drive economic development, support local jobs, and improve the state's water quality and quantity.

To assist in this process, the *Minnesota Water Industry Profile* defines, baselines and benchmarks the industry and identifies opportunities for growth and improvement. Minnesota's water industry includes a variety of companies and organizations that create or provide products or services to improve the use, quality and flow of water. This report focuses on four core water segments: water treatment products & services, water infrastructure products & services, water efficiency products & services, and public water utilities. Key findings include:

- **Employment in the water industry reached 13,500 workers in 2014 and grew three times faster than the state's overall employment in the last decade.** Water treatment products & services is the largest segment, with 38 percent of water industry employment in 2014. The water infrastructure products & services segment comprised 33 percent of industry workers, followed by the public water utilities segment (23 percent) and the water efficiency products & services segment (6 percent). Water efficiency jobs grew the fastest in recent years, though the segment remains relatively small.
- **Water industry workers earn wages well above the state average.** Minnesota water firms paid their workers over \$885 million in wages in 2014, up 15 percent from \$768 million in 2004. Average annual wages in the water industry were \$65,500 in 2014, or 27 percent higher than the statewide average annual wage of \$51,600. Water efficiency products & services average annual wages are the highest in the industry, at \$118,000 in 2014, while public water utility average annual wages are closer to the state average.
- **Minnesota's strong universities and colleges bolster its water industry workforce.** The state's higher education system is preparing the next wave of talented scientists, engineers and operators for a variety of water-related occupations. The University of

Minnesota offers highly regarded water-specific programs, employs some of the nation's leading water technology researchers, and connects industry to ideas and inventions.

- **Minnesota is a leader in water technology patents.** Minnesota companies are developing new technologies, processes and materials that allow industries to operate cleaner and more efficiently. The state ranked 10th nationally in total water technology patents and third in patents per capita in 2014.
- **Minnesota is among the national leaders in water technology exports.** With over \$870 million in water-related technology exports, Minnesota ranked eighth nationally and third in per capita exports in 2014. Minnesota had about \$160 in exports per person in 2014, behind only Texas and Delaware. These exports add value to the state's economy and demonstrate the international strength of the state's companies.
- **Minnesota has an opportunity to develop its emerging water cluster.** The state has a strong and stable water industry, and growing the water cluster provides a chance to create economic wealth and improve the environment. However, other regions, states and countries have also recognized the outsized potential and are aggressively investing in their own clusters. To improve its competitive position, Minnesota could:
 - Increase collaboration among firms and researchers to apply research to solve industry challenges and commercialize new technologies;
 - Create a water cluster organization—comprised of companies and supporting institutions—to foster partnerships, incubate new technologies, pursue federal grants and private investment, and attract water firms, investors and workers;
 - Increase the frequency of water conferences and networking events to help spread ideas and to create connections between entrepreneurs, firms and researchers; and
 - Improve branding and marketing of the cluster by increasing publicity and sharing the region's successes locally, regionally and globally.

Minnesota's water industry is creating high-paying jobs and improving access to clean water across the state and world. There remains, however, a tremendous opportunity to better use, connect and construct resources to support water-related firms. Improvements to this emerging cluster can give the state a meaningful opening to compete in the global market.

INTRODUCTION

Safe, available and affordable water is an important part of economic vitality and public health. Unfortunately, in many places, water supplies are running perilously low. In addition, global trends such as population growth, diet shifts toward more protein, changes in climate and an increasing middle class are increasing the stress on our natural water resources. By 2025, market analysts expect two-thirds of the world population will experience water stress.³ To ease the strain on supplies, new technologies are increasing efficiency and opportunities for water reuse. This pending scarcity presents both a challenge and an opportunity for those companies that can provide solutions. Market analysts suggest the global water market is currently worth \$500-600 billion annually and could reach \$1 trillion by 2020.⁴

Minnesota is home to the headquarters of several of the world's leading water industry companies as well as prominent complementary industries, such as agriculture and food manufacturing, that require clean, available water. Progressive policies have protected and afforded access to the state's 11,842 lakes and 6,564 rivers.⁵ Excellent academic institutions provide Minnesota's water firms with fresh ideas and specialized talent. In addition, public and nonprofit entities are becoming the connective tissue that stitches the industry together.

Across the world, regional clusters of water firms are accelerating innovation, commercializing new technologies and growing the water industry. Regions able to reach this critical mass of firms and supporting organizations are realizing significant economic gains. Minnesota's combination of strong water companies, academic assets, and government and nonprofit support represent an emerging water cluster that can capitalize on growing global demand.

To support Minnesota's water cluster growth, public and private sector entities are investing in supportive institutions, industry networks and inventive technologies. This report profiles Minnesota's water industry in terms of workforce, innovation and exports to create a baseline of the industry and identify opportunities for growth and improvement.

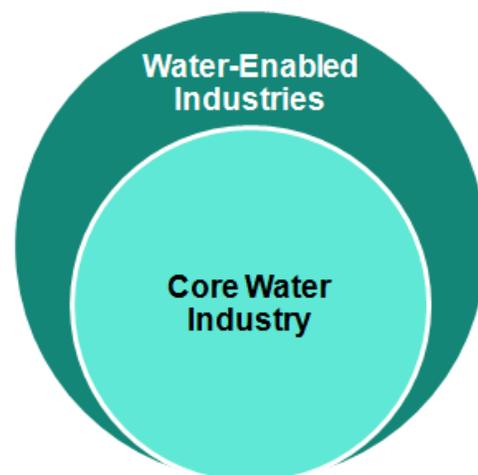
Minnesota's Water Industry

Minnesota's water industry includes a variety of companies and organizations that create or provide products or services to improve the use, quality and flow of water. This report focuses on four core water segments: water treatment products & services, water infrastructure products & services, water efficiency products & services, and public water utilities (Table 1). The water industry includes activities across the value chain, such as manufacturing; research & development (R&D); management, sales or distribution of water-related products, components or services; and conservation, monitoring or management.

Table 1

Minnesota Core Water Industry Segments		
	Treatment Products & Services	Products and services for treating/cleaning water for use, reuse or returning to the environment. Includes technologies such as filtration/purification, disinfection (chemical and UV), desalination, aeration and contaminant detection.
	Infrastructure Products & Services	Products or services for managing the movement of water, including technologies and services like pumps, pipes, irrigation, tile drainage, water and sewer line construction and repair, water wells and agricultural water management.
	Efficiency Products & Services	Products or services to save water, with technologies such as meters and controls, leak detection, water conservation, energy efficiency and low flow fixtures.
	Public Water Utilities	Utilities or public/nonprofit organizations that manage water availability and quality, including water and wastewater treatment facilities, water resource recovery, water quality monitoring, stormwater management and watershed districts.

Minnesota, with its famous lakes and the headwaters of major rivers, has abundant water availability. Combining this water resource with local technologies and services provides an economic opportunity for the state. A strong core water industry creates opportunities for water-enabled industries that rely on clean and readily available water. This grouping includes agriculture, fishing, manufacturing (including food and beverage manufacturing), mining and shipping. Water-enabled industries create much of the demand for core water companies and benefit most from new, inventive water products and services.



By growing its core water industry and expertise across the value chain, Minnesota can increase revenue and exports of water products. In addition, the state could increase its attractiveness as a destination for the myriad of industries that need cheap, abundant water for production.

Examples of Minnesota Organizations Active in the Water Industry

<p>3M</p> <p>3M, a global company founded in Minnesota in 1902, manufactures water treatment and filtration products, and sensors that detect infrastructure leaks. One innovative 3M technology offers allows utilities to insert a robotic spray head into a water transmission line and apply a liner that helps prevents corrosion and tuberculation and seals cracks, pinholes and pitting. The pipe can often be reinstated in a single day. This technology has tremendous potential: the EPA estimates U.S. municipalities will need to spend \$247 billion over the next 15 years to fix water pipes.</p>	<p>Ecolab</p> <p>Ecolab delivers comprehensive solutions and on-site service to promote safe food, maintain clean environments, optimize water and energy use, and improve operational efficiencies for customers. In 2014, Ecolab partnered with the Cold Spring, Minnesota, plant of Gold'n Plump (the largest fully integrated producer of fresh chicken products in the upper Midwest) to implement an innovative poultry washing process that saved the company 68 million gallons of water.</p>
<p>Aeration Industries International</p> <p>Based in the Twin Cities, Aeration Industries International is a global leader in surface aeration and wastewater treatment technologies. Over the last 40 years, the company has installed more than 70,000 systems in all 50 states and more than 92 countries.</p>	<p>Metropolitan Council</p> <p>The Metropolitan Council's Environmental Services Division provides wastewater services and integrated planning for the Twin Cities region. It operates and maintains eight wastewater treatment plants, treating an average of 260 million gallons of wastewater a day for about 2 million residents.</p>
<p>Dow Water & Process Solutions</p> <p>Dow Water & Process Solutions, a business unit of The Dow Chemical Company, is a global provider of water treatment and water purification solutions. With more than 50 years of experience, Dow provides innovative, technology-based solutions to a broad spectrum of water issues including producing pure water for manufacturing, eliminating impurities from chemical processes and conserving water through reuse and recycling.</p>	<p>Pentair</p> <p>Pentair is one of the world's largest manufacturer of valves, actuators and filtration and control products. These products service diverse industries, including energy, food and beverage, and municipal. In 2012, Pentair merged with Tyco Flow Control. The acquisition positions Pentair to improve innovation and efficiencies at the nexus of water, energy, food and other resources for fast-growing markets like China and India.</p>
<p>Minnepura Technologies</p> <p>Minnepura Technologies, launched in 2014, uses bacteria-based biotechnology to make contaminated water safe and useful. This technology, licensed with help from the Office for Technology Commercialization, is based on work by University of Minnesota researchers affiliated with the BioTechnology Institute.</p>	<p>Tonka Water</p> <p>For 59 years, Tonka Water has provided customized water treatment solutions. The company designed, manufactured and installed more than 2,300 individually designed water treatment systems for municipalities across North America. Tonka Water's products include membrane systems, filters, aerators and clarifiers for wastewater treatment environmental remediation and industrial process projects.</p>

MINNESOTA'S WATER INDUSTRY WORKFORCE

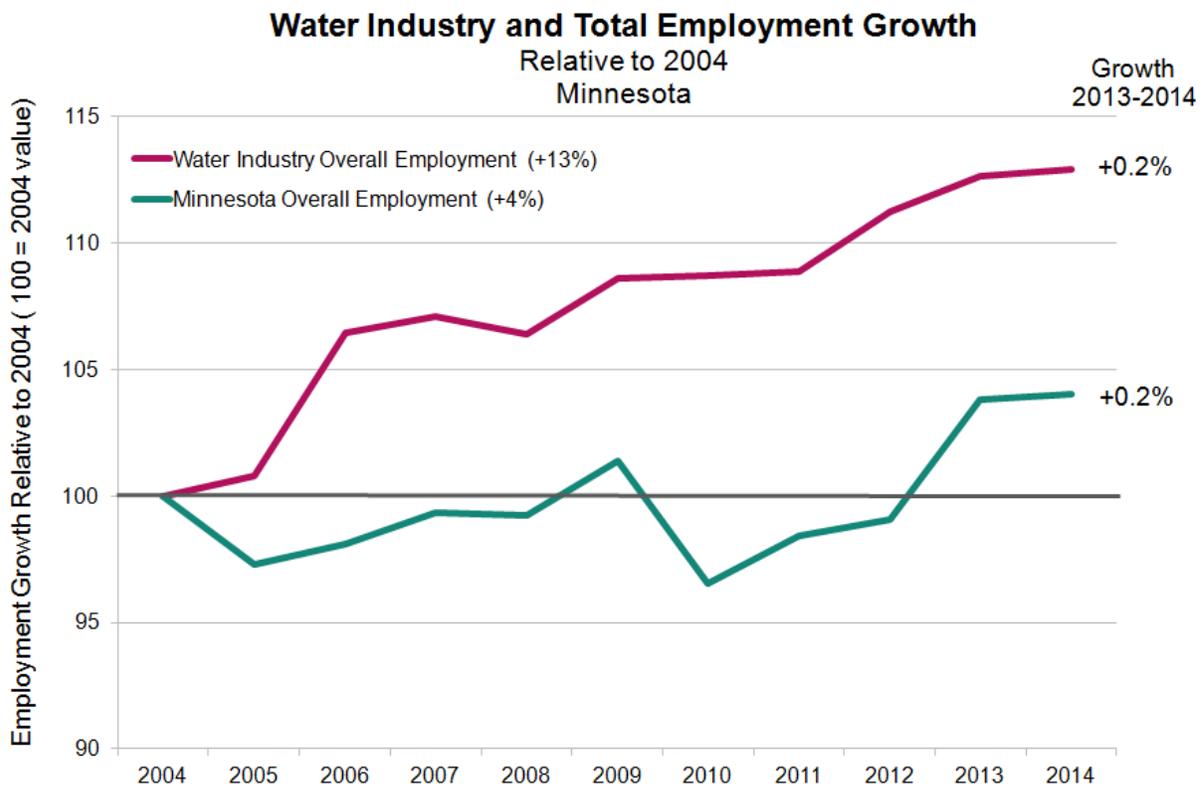
Employment

Minnesota's water industry includes a variety of small, medium and large corporations that provide products and services to improve the use, quality and flow of water. This report focuses on companies and business units in four core water segments: water treatment products & services, water infrastructure products & services, water efficiency products & services, and public water utilities (see Table 1 for descriptions). Water companies in Minnesota are active across the value chain, from manufacturing and research to installation, maintenance and sales.

Water Industry Employment

The state's water industry employed about 13,500 workers in 2014 and grew three times faster than overall state employment in the last decade. Water industry employment grew 13 percent between January 2004 and first quarter 2014, while the state's total employment grew 4 percent (Figure 1). Between the first quarters of 2013 and 2014, employment in the water industry and state overall grew at the same rate (+0.2 percent).

Figure 1



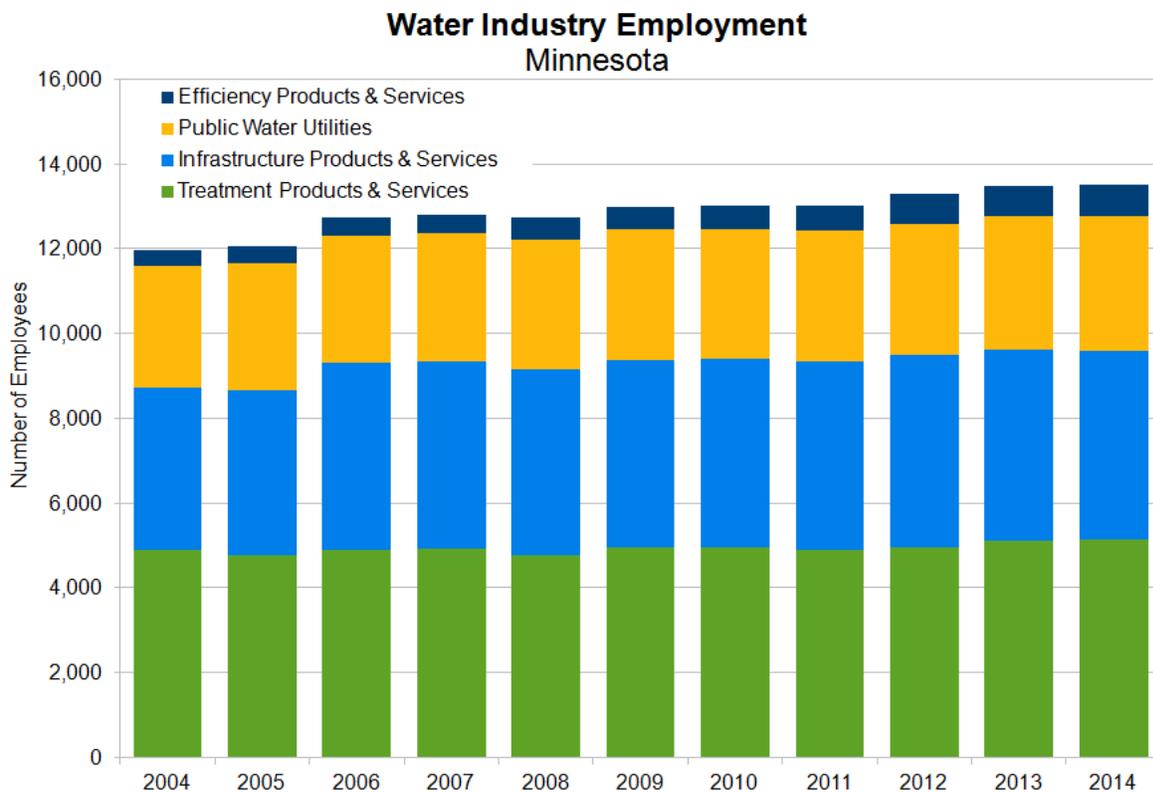
Data Source: National Establishment Time Series Database, IEGC, MN DEED Survey as of May 30, 2015
Analysis: Collaborative Economics

Figure 2 illustrates the number of water industry employees by segment over time. The water treatment products & services segment employed more than 5,100 workers in first quarter 2014,

up 5 percent compared to January 2004 (Figure 3). Water infrastructure products & services is the second largest segment with nearly 4,500 total jobs in first quarter 2014. This segment also added the most jobs in the last 10 years, with over 600 more workers compared to January 2004 (+17 percent). The public water utilities segment grew 10 percent in the last decade, reaching more than 3,100 workers in first quarter 2014.

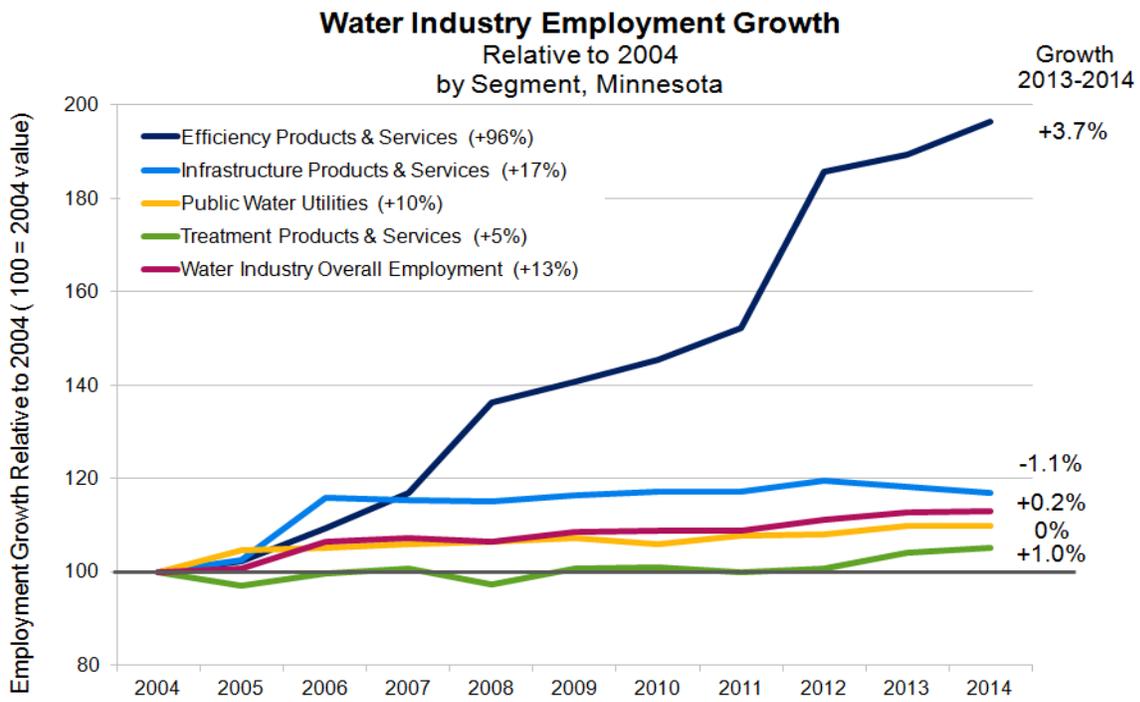
The water efficiency products & services segment had the fastest growth between 2004 and 2014, nearly doubling employment to about 750 jobs, but remains a small segment of the state's water industry. This rapid growth was concentrated in a small number of large corporations active in the water industry.

Figure 2



Data Source: National Establishment Time Series Database, IEGC, MN DEED Survey as of May 30, 2015
 Analysis: Collaborative Economics

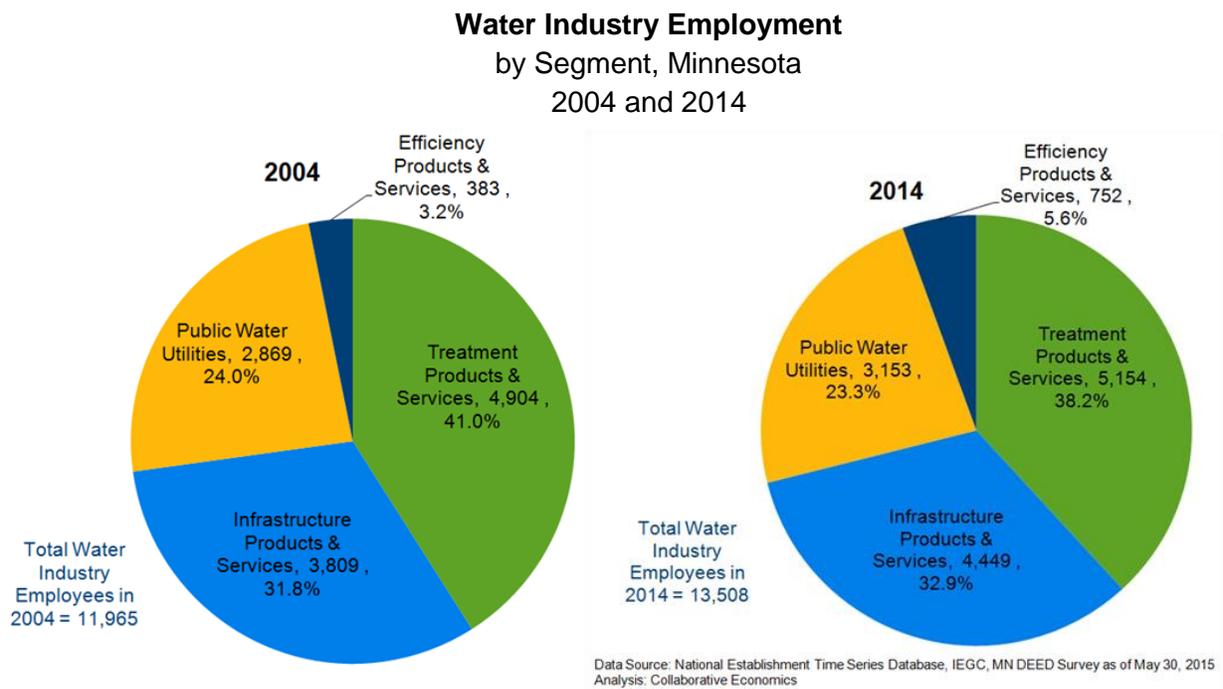
Figure 3



Data Source: National Establishment Time Series Database, IEGC, MN DEED Survey as of May 30, 2015
 Analysis: Collaborative Economics

The distribution of workers in these four water industry segments remained relatively constant between 2004 and 2014 (Figure 4). Water treatment products & services is still the largest segment, with about 38 percent of water industry employment in 2014. The water efficiency products & services segment is a small portion of total industry employment, though its relative share increased the most between 2004 and 2014, up 2.4 percentage points. The proportion of jobs in the water infrastructure products & services segment also increased, while the share of public water utilities workers decreased slightly.

Figure 4



Water Industry Establishments

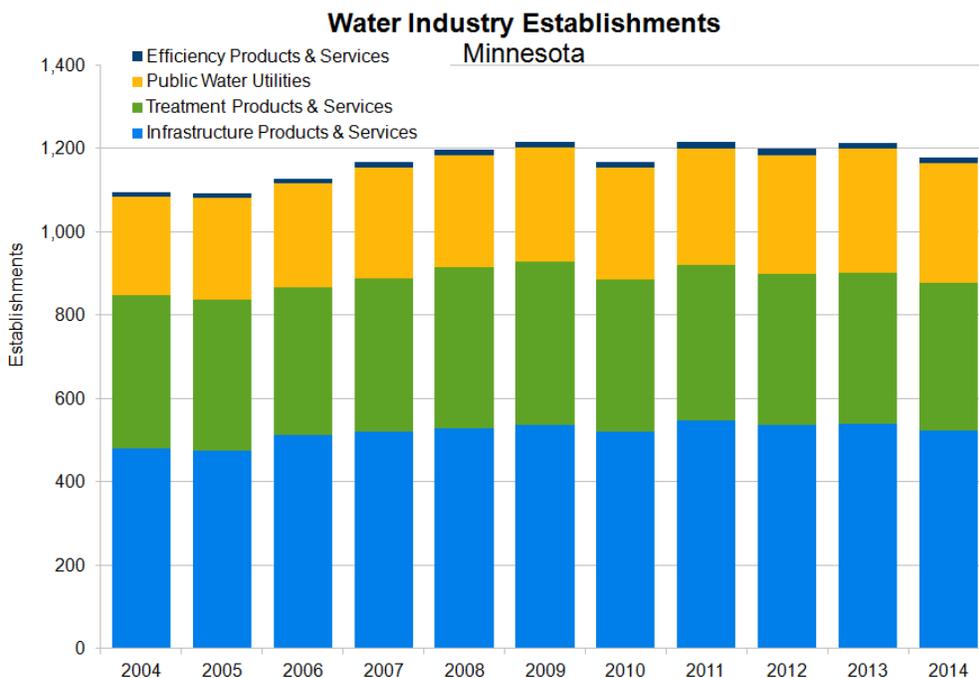
Minnesota's water industry had nearly 1,200 establishments in first quarter 2014, up nearly 8 percent since 2004 (Figure 5). The total number of establishments in the water industry decreased nearly 3 percent between the first quarters of 2013 and 2014, primarily due to the closure of small establishments (five jobs or fewer). This decrease is less than establishments in the statewide economy overall, which dropped 7.5 percent in the same period.

Establishments are individual business locations. Enterprises (a private firm, government, or nonprofit) can consist of a single or multiple establishments. For example, each local Culligan store is an individual establishment.

Water establishments in Minnesota are primarily small businesses. About 80 percent of water establishments in the state have 10 employees or fewer, and 97 percent of establishments have fewer than 50 employees. The remaining 3 percent of establishments are large firms that comprise nearly half of the total water industry employment.

While water treatment products & services had the most jobs, it had the second highest number of establishments (30 percent). These establishments range from larger companies that develop water filters, membranes and process solutions, to smaller residential water softener and purification companies. The water infrastructure products & services segment had the most (44 percent) establishments, with a large number of relatively small employers such as water well drilling companies. Public water utilities vary based on the size of the service area, and range from small local water treatment plants to metropolitan-wide operations such as St. Paul Regional Water Services.

Figure 5



Data Source: National Establishment Time Series Database, IEGC, MN DEED Survey as of May 30, 2015
Analysis: Collaborative Economics

Regional Water Industry Employment

Minnesota's water industry builds on a range of assets and activities within its regions. The seven geographical regions used in this analysis are defined by the Minnesota Initiative Foundations, and are aggregate groupings of the 13 economic development regions serviced by Minnesota DEED.⁶ These regions have different strengths in the water industry, based on a variety of factors such as local resources, historical industries, workforce capacity and supporting institutions.

The map in Figure 6 factors in regional employment levels and shows that the Central region has the highest statewide concentration of water industry employees, driven by a few large companies in the region. The Central region has the second largest number of water industry employees, with nearly 1,800 jobs and had the largest growth rate in the last decade, with employment up 72 percent in 2014 compared to 2004.

The Twin Cities have the most water-related jobs and mirrors the region's share of total jobs in the state (Figure 7). In addition, the Twin Cities is home to the headquarters of many of the state's large companies active in the water industry, such as Ecolab and Pentair. The region had about 8,100 employees in the water industry as of first quarter 2014, up 8 percent compared to January 2004.

The Southern region had the third highest number of water industry employees, with nearly 1,400 in first quarter 2014. Water employment in the region grew 8 percent between 2004 and 2014, and recently jumped in some companies, such as Zumbrota-based startup, WaterFilters.net.

The Southwest and West Central regions also had an above average concentration of water industry employment, though overall water industry employment is relatively low at about 800 and 500 employees in 2014, respectively. The Northland and Northwest regions had an employment concentration slightly below the state average, with 630 and 230 employees in 2014, respectively, and both grew 4 percent in the last decade.

Figure 6

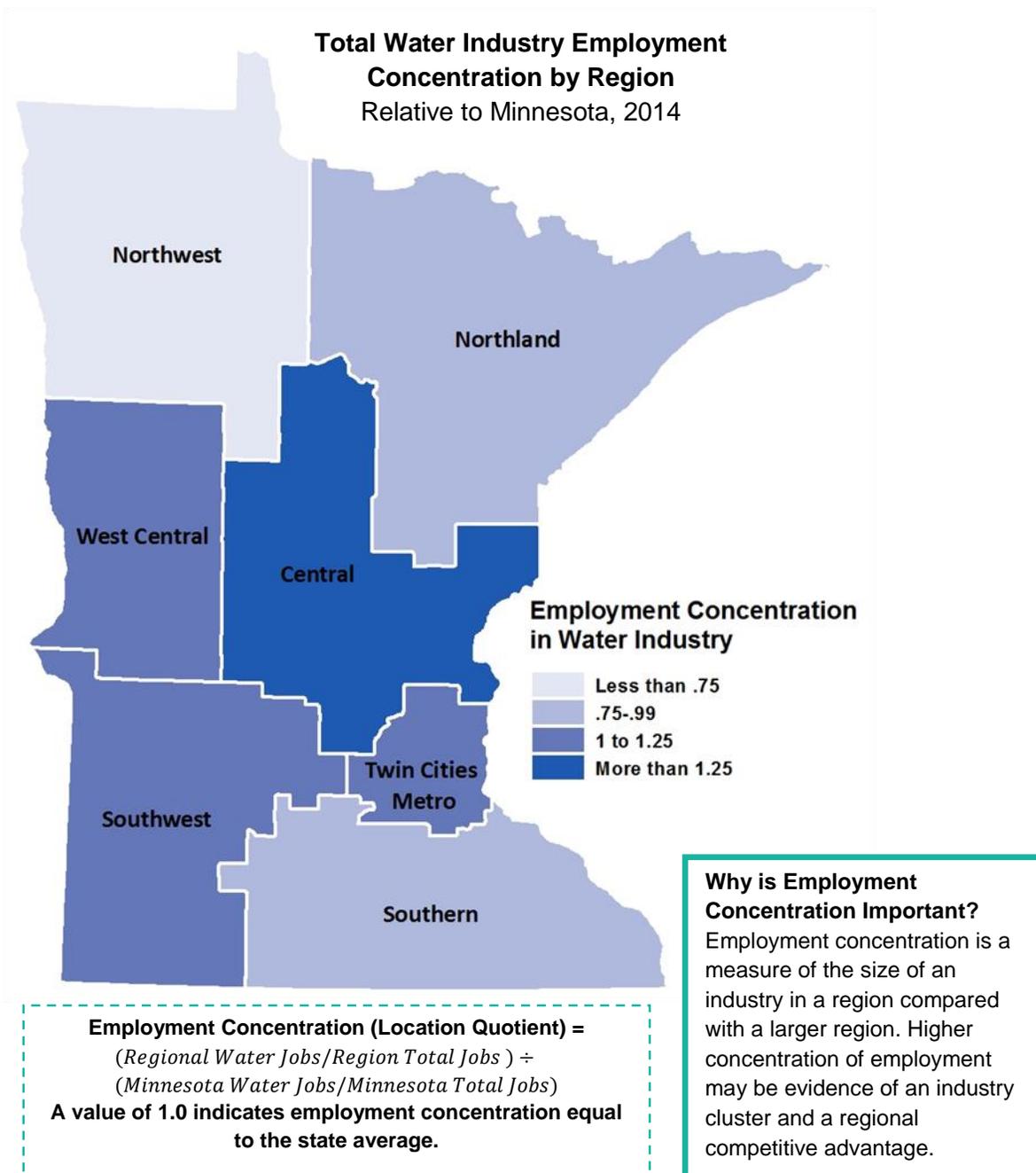
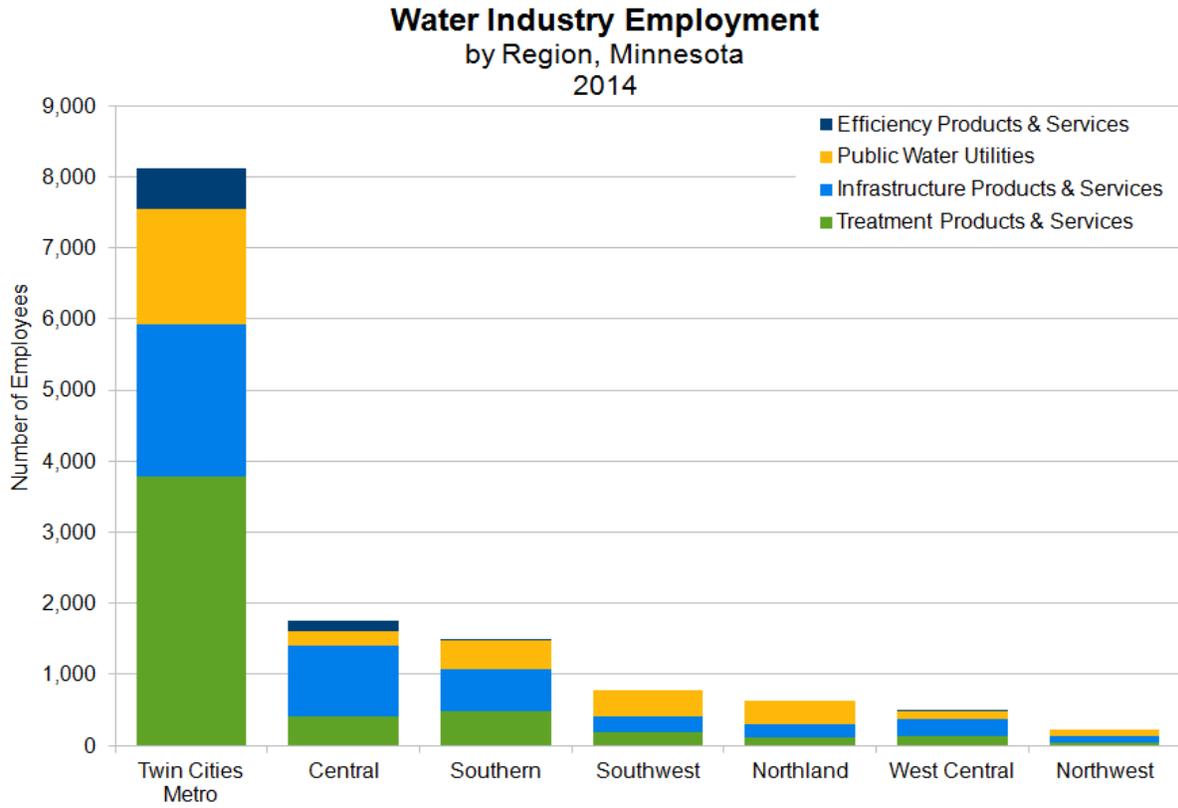


Figure 7



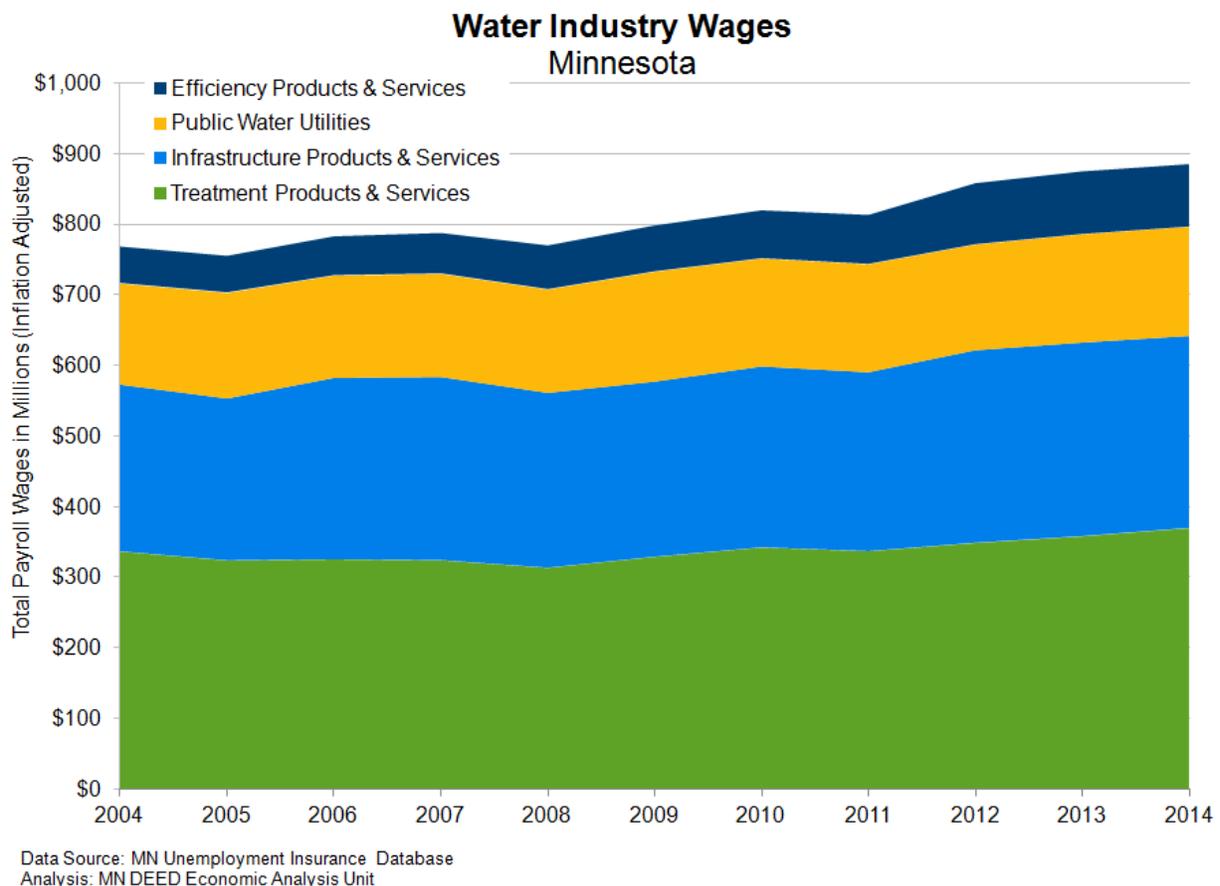
Data Source: National Establishment Time Series Database, IEGC, MN DEED Survey as of May 30, 2015
Analysis: Collaborative Economics

Wages

Minnesota workers in the water industry brought home over \$885 million in wages in 2014, up 15 percent from about \$768 million in 2004 (full year wages, inflation adjusted to 2014 dollars) (Figure 8). Changes in water industry wages mirror the increase in employment over the same period.

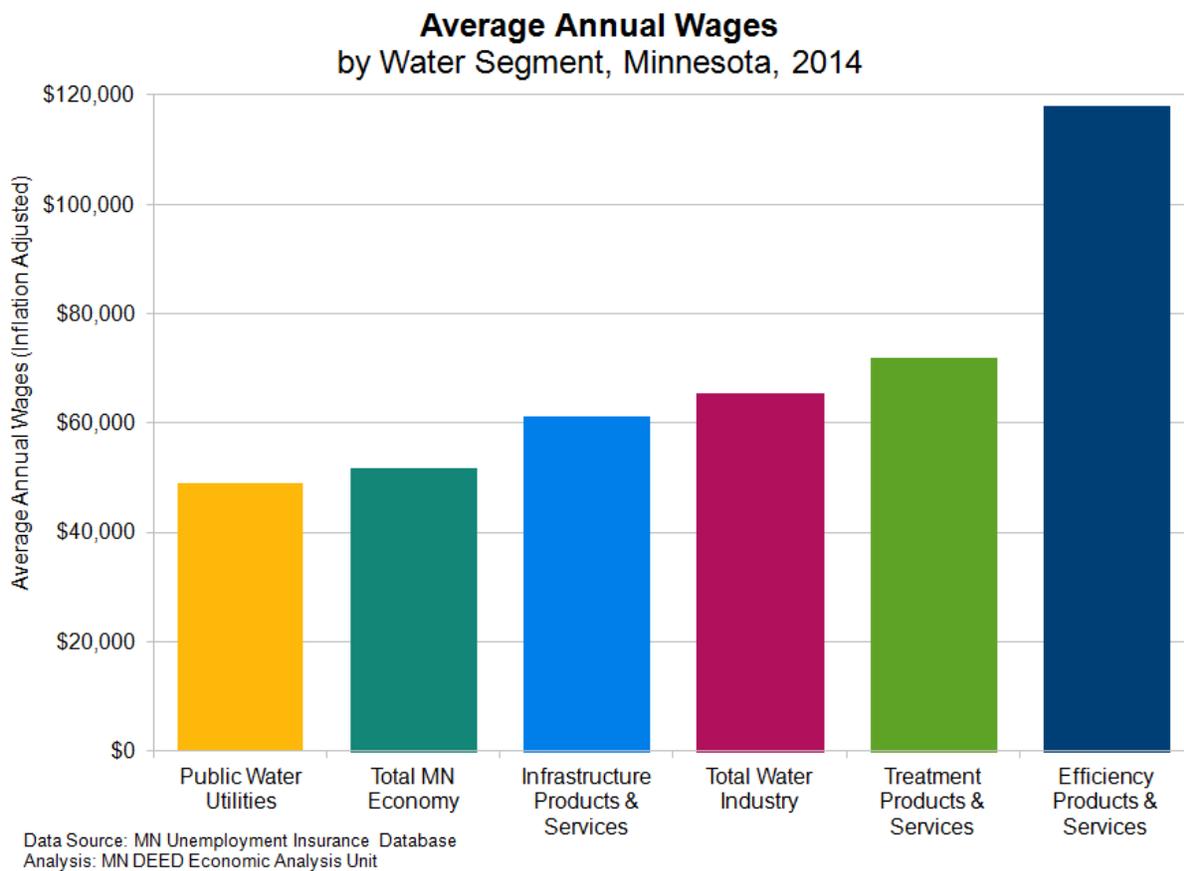
The water efficiency products & services segment achieved the highest percent change over the last decade (+71 percent) to reach nearly \$89 million in 2014. It also grew the most in total segment wages, with nearly \$37 million more in wages in 2014 compared to 2004. This high growth in total segment wages reflects the high average annual wage in water efficiency products & services. Water treatment products & services had the largest total segment wages of \$370 million in 2014. Water infrastructure products & services was second at \$272 million, and public water utilities wages were at nearly \$155 million in 2014. All segments increased total wages between 2004 and 2014.

Figure 8



Water industry jobs, on average, pay wages above the state average (Figure 9). Average annual wages in the water industry were about \$65,500 in 2014, or 27 percent higher than the statewide average annual wage of \$51,600. Total water industry average annual wages and segment wages stayed steady over the last 10 years, with total water industry wages up 2 percent in 2014 compared to 2004 (inflation adjusted). Water efficiency products & services average annual wages are the highest in the industry, at about \$118,000 in 2014. This high average wage is partially a byproduct of efficiency jobs concentrated in a relatively small number of large corporations headquartered in the Twin Cities. Public water utility average annual wages are the lowest of the four segments at \$49,000.

Figure 9



Occupations

The water industry includes workers in a wide range of occupations, with 16 key occupations identified as directly related (Table 2). A high concentration of water occupations (i.e. location quotient greater than one) indicates locally available and industry specialized talent. Minnesota has an above average concentration of workers in these occupations and ranks in the middle (23rd) for overall water-related occupation concentration, just above neighboring Wisconsin (26th) and below Michigan (20th). Minnesota has a particularly high concentration of water treatment plant operators, hydrologists and filtering machine operators. The occupations with a below average concentration, such as engineers, may indicate a workforce development opportunity in the state.

These water-related occupations offer a variety of opportunities for Minnesotans with all levels of educational attainment. Several water-related occupations typically need only a high school diploma or associate degree, while others require a bachelor's degree or higher. Most of the occupations are in engineering, science and facilities operations. In addition, many of these occupations offer an average annual wage close to or higher than the state average of \$51,600.⁷

Table 2

Concentration of Water-Related Occupations in Minnesota Compared to the U.S. Average				
Occupation Code*	Occupation Name	Location Quotient** in Minnesota, 2014	Average Annual Wage 2014	Typical education needed for entry
19-2043	Hydrologists	2.50	\$ 73,210	Master's degree
51-9012	Separating, Filtering and other Machine Setters, Operators, and Tenders	1.87	\$ 44,690	High school diploma or equivalent
51-8031	Water and Wastewater Treatment Plant and System Operators	1.37	\$ 48,730	High school diploma or equivalent
19-1031	Conservation Scientists	1.35	\$ 67,050	Bachelor's degree
19-1021	Biochemists and Biophysicists	1.17	\$ 72,500	Doctoral or professional degree
11-9121	Natural Sciences Managers	1.06	\$ 112,230	Bachelor's degree
19-4031	Chemical Technicians	1.04	\$ 49,520	Associate degree
19-2031	Chemists	0.99	\$ 93,410	Bachelor's degree
17-3025	Environmental Engineering Technicians	0.93	\$ 48,690	Associate degree
17-2199	Engineers	0.89	\$ 93,550	Bachelor's degree
19-2041	Environmental Scientists and Specialists	0.88	\$ 66,760	Bachelor's degree
17-2041	Chemical Engineers	0.82	\$ 89,480	Bachelor's degree
17-2111	Health and Safety Engineers	0.75	\$ 83,980	Bachelor's degree
19-4021	Biological Technicians	0.71	\$ 49,970	Bachelor's degree
17-2081	Environmental Engineers	0.71	\$ 77,790	Bachelor's degree
17-2131	Materials Engineers	0.63	\$ 89,700	Bachelor's degree
	Total Water-Related Occupations	1.03		

*Occupation codes are defined by the Bureau of Labor Statistics and are used to classify workers into occupational categories for the purpose of collecting, calculating, or disseminating data. All workers are classified into one of 840 detailed occupations according to their occupational definition.

**Location Quotient is the same calculation as employment concentration in Figure 6, and is a measure of the size of an occupation in the state compared with the U.S. A location quotient higher than 1 indicates an above average concentration of workers in that occupation.

Data Source: Bureau of Labor Statistics and Greater MSP
Analysis: MN DEED and Collaborative Economics

Education and Research

Minnesota's strong education system and research programs bolster its water industry workforce. The state's public and private colleges and universities play a critical role in training the next generation of industry workers. These institutions, along with private companies, drive water technology innovation with cutting-edge research.

Minnesota's higher education system offers several options for two- or four-year technical degrees, as well as graduate and doctoral degrees, that could lead to water-related jobs (such as those occupations listed in Table 2). Colleges and universities across the state offer a variety of engineering and science programs. In particular, the University of Minnesota-Twin Cities (UMN) campus is one of the nation's top research universities.⁸ In addition, several campuses have developed specialized water-related programs to give students industry-specific knowledge and experience.

UMN has a strong foundation in water-related education and research with the College of Science and Engineering, College of Food, Agriculture and Natural Resource Sciences, College of Biological Science and other applied science degree programs. UMN leverages this strength to provide the largest and most diverse water-specific education offerings in the state. The UMN also houses the [Water Resources Center](#), which is a congressionally authorized water resource research institute that focuses on freshwater management. The Center offers four research areas (Agricultural Impacts on Water Quality; Stormwater and Wastewater; Water Resources Policy and Social Science; and Water Supply, Quantity and Quality) as well as four training and professional development programs (Onsite Sewage Treatment Program; Wetland Delineator Certification Program; Conservation Applications of LiDAR Data; and Conservation Drainage Field Days).

In addition, other institutes and centers at UMN, such as the [Institute on the Environment](#), [Limnological Research Center](#), [St. Anthony Falls Laboratory](#) and the [Biotechnology Institute](#), offer water-related programs and opportunities to connect water issues with agriculture, energy, biotechnology and other important topics. As an example, the St. Anthony Falls Laboratory completed a \$16 million renovation in 2014 (partly funded from a \$7.1 million grant from the National Science Foundation as part of the American Recovery and Reinvestment Act of 2009) to conduct state-of-the-art research and work on creative solutions to the world's environmental, water resources and energy-related problems.

The University of Minnesota-Duluth has water-specific programs. For example, the [Large Lakes Observatory](#) is the only institute in the U.S. dedicated to the study of the functioning, fundamental processes, environmental interactions and histories of large lakes worldwide. In addition, the [Natural Resources Research Institute](#) focuses on studying the economic impact and sustainability of resources, including water, and includes a Center for Water and the Environment to advance water-specific research.

Minnesota's community college system offers several water-related programs. St. Cloud Technical and Community College's [Water Environment Technologies](#) program trains technicians in water and wastewater treatment. Vermilion Community College's [Water Quality](#)

[Science and Operations Program](#) trains students in water science, water use and wastewater treatment and general usage. In addition, Normandale Community College's [Vacuum and Thin Film Technology](#) prepares students to work in industries that manufacture vacuum-based products. These programs provide the skills and access to high-quality jobs in a growing industry without the time and expense of a four-year degree.

Two focal points for Minnesota-funded water-related research are the [Legislative-Citizen Commission on Minnesota Resources](#) (LCCMR) and [Minnesota's Discovery, Research and InnoVation Economy](#) (MnDRIVE), via the University of Minnesota.

LCCMR makes funding recommendations to the legislature for special environment and natural resource projects, primarily from the Environment and Natural Resources Trust Fund. This permanent, voter-approved fund provides a long-term source of funds for research that protect and enhance Minnesota's environment and natural resources for public benefit. Since 1991, the fund provided more than \$500 million for 1,000 projects throughout the state, including water resource-related research by academic, public and private researchers.

The Minnesota Legislature authorized MnDRIVE in 2013 with \$36 million in seed money. The goal of this program is to align the university with emerging industries to advance research in four main areas: environment, robotics, global food and brain conditions. The environment program currently focuses on developing technologies around bioremediation to solve water quality and environmental challenges, as well as collaborating with industry leaders to apply this research to business and environmental problems.

MnDRIVE is also playing an important role in connecting researchers, industry and government. For example, grant applications now require an industry partner in research projects in an effort to solve industry problems and advance technologies. In addition, MnDRIVE hosts listening sessions and symposia with business leaders to learn more about their research needs, with the goal of partnering companies with researchers to solve common problems. These sessions have already resulted in several connections between companies and researchers, as well as industry-industry connections.

The University of Minnesota also has programs that are not water-specific that can be leveraged to advance research and industry partnerships. For example, [Minnesota Innovation Partnerships](#) fosters partnerships between academics and business to develop creative solutions. This program provides companies with a low-cost, low-risk method to license existing university-developed technologies and provides a streamlined process for companies to sponsor research and license technology.⁹ The University's [Office for Technology Commercialization](#) also helps bridge the gap between the lab and market for researchers and companies.¹⁰

Research in Action:

In 2013, **American Peat Technology** signed a research agreement under the Minnesota Innovation Partnerships program to partner with the University of Minnesota-Duluth's Natural Resource Research Institute. Together, these partners are exploring new ways to use peat to remove harmful pollutants from mine water.

One of the primary challenges for water research in the state is connecting academic researchers and businesses to advance innovation, particularly given the large and diverse university system and the lack of a central contact for water-related programs. These industry research connections can be beneficial for both parties, through commercializing university-based technologies or applying research expertise to industry problems like mining water contamination. While programs such as MnDRIVE are improving industry and researcher connections, there is room for growth. This challenge presents an opportunity for the university system to develop and improve formal and informal programs to increase connections to the water industry. The box below highlights a few examples of strategies for increasing industry connections that are in place across the country.¹¹ The university does have some of these activities already in place as noted above, though strategies to focus on water-related programs and research could be beneficial to improve industry connections.

Example Strategies for Increasing Industry Connections with Universities to Advance Innovation

- A **corporate affiliate program** is a formal mechanism that can operate at the university program level to build and maintain collaborative relationships with businesses. Some universities have multiple programs, such as those at the [University of California San Diego](#) and [Stanford University](#).
- An **industry broker** or [entrepreneurs-in-residence](#) at a university or program can increase connections to industry and facilitate matchmaking among researchers, students and businesses, as well as advancing commercialization of technologies. Examples include [Iowa State University](#) and [Harvard University](#).
- **Multidisciplinary research centers** or institutes with industry partners can provide a platform for collaborative research. The [Renaissance Computing Institute](#), for example, includes three university partners, government and industry to advance innovation and solve real-world problems.

INNOVATION IN THE WATER INDUSTRY

Innovation is crucial to meet demand for more efficient products and move the industry forward. This demand drives water companies to develop technologies, processes and materials that allow new and existing industries to operate clean and efficiently. Water innovation includes corporate research, university labs and research centers, startup business activity, business and technology incubators, and more. Since innovation can be difficult to measure directly, researchers use a number of proxy data points. This section evaluates investments and patents, two of the common measures of innovation.

Investments

To move from an idea to prototype to commercial product, researchers, inventors and entrepreneurs need capital. Early stage investments, like venture capital, grants and loans, are an indicator of how active investors are in helping Minnesota entrepreneurs bring their ideas to market.

According to analysis of the Cleantech Group's i3 database and Small Business and Innovation Research (SBIR) grants, Minnesota companies received more than \$2.2 million in early-stage investment between 2008 and 2013 to develop and commercialize water-related technologies. About two-thirds of that investment was from federal SBIR grants. These SBIR grant awards help companies develop water technologies, such as an award to United Science LLC to develop sensors to monitor environmental contaminants found in wastewater and drinking water. In this project, United Science LLC is also taking advantage of membrane technology licensed from the University of Minnesota.

The early-stage water-related investment amount is relatively small compared to spending on public water infrastructure or research in the state. This funding gap presents an opportunity for policies and/or programs to foster early-stage investment.

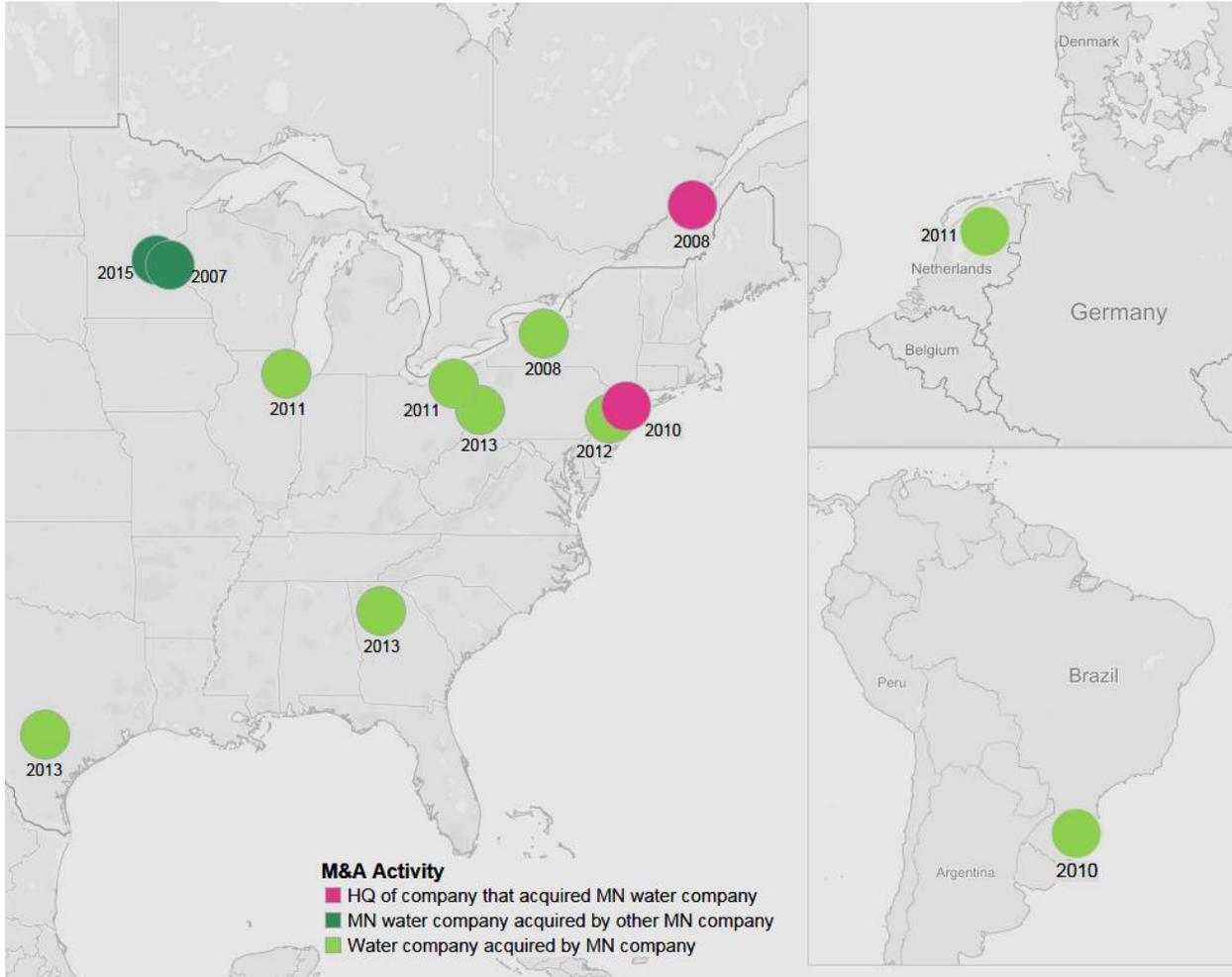
Early-stage companies can also receive investment and grow through a merger and/or acquisition (M&A). Jobs are likely to increase or stay in the state if a local company purchases another local company. Conversely, if a Minnesota company acquires an outside firm, the growth may be concentrated out of state. Similarly, if an outside company acquires a Minnesota firm, there is a risk of losing those jobs. Minnesota has an opportunity to foster early-stage water company development in the state to encourage in-state M&As and increase local water jobs.

Since 2007, Minnesota companies have been involved in 13 water company M&As (Figure 10). Minnesota companies merged with or acquired 11 water companies, nine of which were based outside the state. For example, in 2011, Minnesota-based Ecolab expanded its water technology portfolio through a \$5.4 billion acquisition of Illinois-based Nalco. Two of the M&As were a Minnesota company buying another Minnesota-based water company. In 2015, for example, ALLETE, a power company based in Duluth, Minn., acquired an 87 percent stake worth \$168 million in U.S. Water Services, an integrated industrial water management company based in St. Michael, Minn. Two out-of-state companies acquired a Minnesota water company,

including the 2008 acquisition of the Minneapolis-based water treatment company Itasca Systems by a Canadian company, H2O Innovation.

Figure 10

Merger & Acquisition Activity of Water Companies Minnesota, 2007-2015



Data Source: Cleantech Group, i3 database
Analysis: Collaborative Economics
Visualization: DEED Economic Analysis Unit

Patents

Patents measure an important aspect of innovation: the output of research efforts to produce intellectual property. Minnesota is among the national leaders in water-related patent activity. In 2014, Minnesota ranked 10th in total water patents, with 30 water technology patent published applications, above Wisconsin at 11th (Table 3). In water patents relative to state population (per capita), Minnesota was third in the nation in 2014. In the last five years (2010-2014), Minnesota had 165 water technology patents, ranking ninth among U.S. states.

Table 3

Top Ranking States in Water Technology Patents					
	Total Water Patents in 2014	Rank 2014	Patents per Capita Rank 2014	Total Water Patents in 2010-2014	Rank 2010-2014
California	137	1	9	732	1
Texas	73	2	16	328	2
Michigan	59	3	1	214	4
Pennsylvania	50	4	8	212	5
Illinois	45	5	10	196	6
New York	40	6	26	179	7
Florida	40	6	27	218	3
Massachusetts	39	8	2	175	8
Ohio	37	9	12	149	10
Minnesota	30	10	3	165	9
Wisconsin	29	11	5	113	12

Note: Patents are published patent applications, by location of inventor.
 Data Source: Cleantech PatentEdge
 Analysis: Collaborative Economics

Ecolab, Embro Corporation, 3M, General Electric and EcoWater Systems were among the top patenters between 2010 and 2014 (Table 4). Most of these companies are located in the Twin Cities, and this clustered patenting activity can encourage friendly industry competition and partnership opportunities. These companies are creating new technologies primarily to improve water efficiency and treatment, such as filtering and membrane technologies, and water and energy saving detergents and cleaning technologies.

Table 4

Top 10 Assignees for Water Technology Minnesota Patents 2010-2014 Patents		
Rank	Company Name	Total Water Patents
1	Ecolab	28
2	Embro Corporation	15
3	3M	8
3	General Electric	8
5	EcoWater Systems	7
5	Honeywell International	7
7	NanoH2O	4
8	Aeration Industries International	3
9	Donaldson Company	2
9	Electrolux Home Products	2
9	Johnson Screens	2
9	Mix Manufacturing	2
9	O3 Industries	2
9	Pur Water Purification Products	2
9	University of Minnesota	2
9	Tennant Company	2
9	The Good Water Company	2

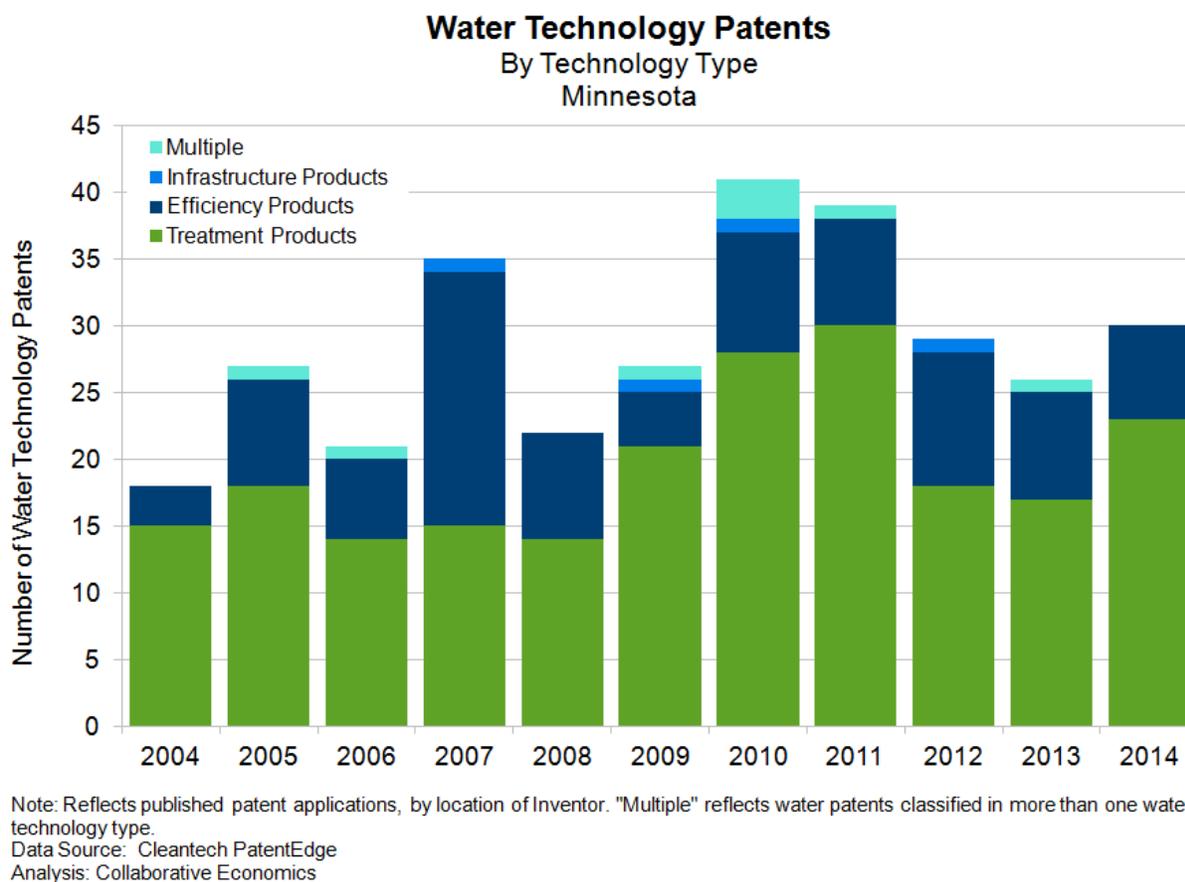
Note: Patents are published patent applications, by location of inventor.

Data Source: Cleantech PatentEdge

Analysis: Collaborative Economics

The number of patents published by Minnesota inventors stayed relatively constant over the last 10 years, with an average of 29 patents annually (Figure 11). These patents represent an average of 4 percent of the total U.S. water patents. Minnesota inventors specialize in developing new water treatment technologies, comprising about two-thirds or more of the total water technology patents in the state.

Figure 11



Stakeholders in Minnesota could help spur innovation, investment and new patents by creating a supportive network for entrepreneurs. For example, the University of Minnesota could increase the funding for programs such as the Minnesota Innovation Partnerships that improve access to university-developed technology. Alternatively, a cluster organization or accelerator could help entrepreneurs and small companies connect with potential investors, provide assistance with intellectual property questions, or navigate the complex patent system.

WATER TECHNOLOGY EXPORTS

In 2014, Minnesota firms exported over \$870 million worth of water-related technologies internationally. This category of water technology exports, as defined by the U.S. Department of Commerce's Environmental Technologies Trade Advisory Committee, includes exports such as certain types of pumps, valves, and filtering and purifying devices. These exports illustrate the value added to the state's economy and the global presence of the state's companies. Between 2004 and 2014, water product exports totaled \$7.2 billion. Nationally, Minnesota ranks eighth in total water technology exports.

Table 5

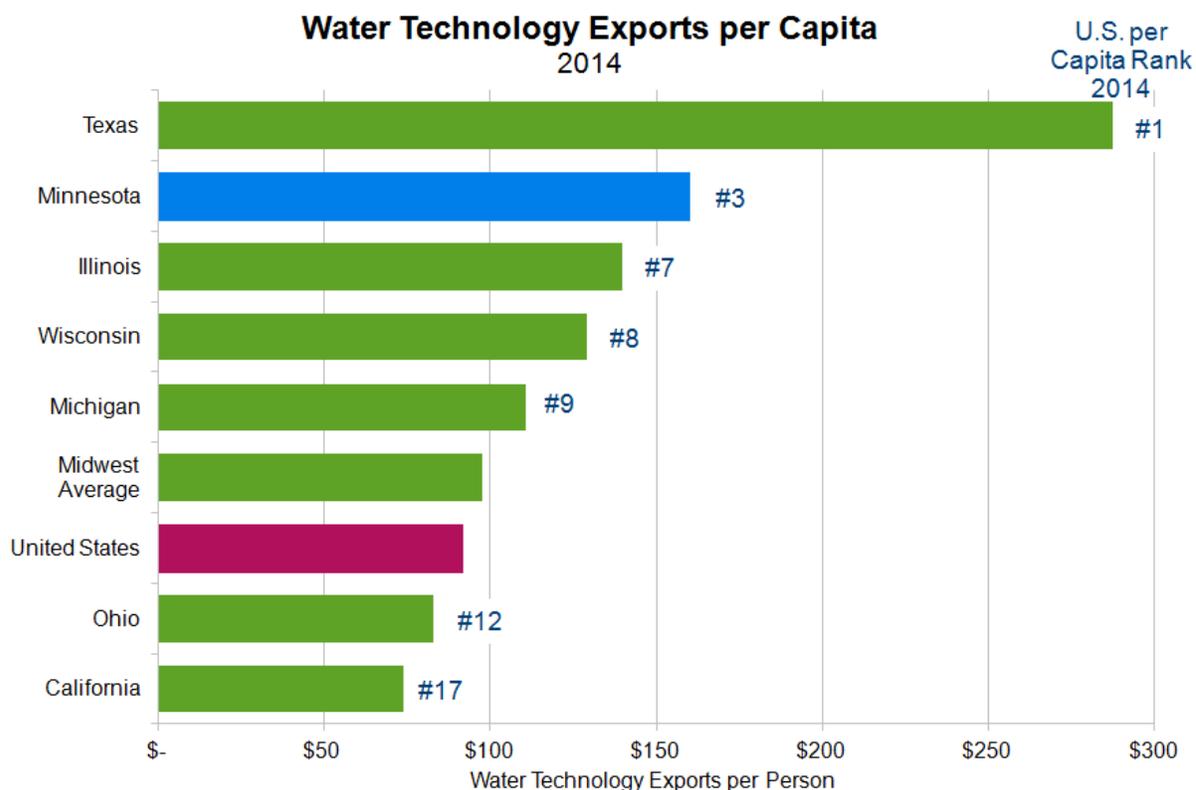
Table 5

Water Technology Exports 2014		
Rank in Total Exports	State	Total Exports in Millions
	United States	\$ 29,224
1	Texas	\$ 7,753
2	California	\$ 2,862
3	Illinois	\$ 1,800
4	Michigan	\$ 1,098
5	Massachusetts	\$ 999
6	New York	\$ 964
7	Ohio	\$ 959
8	Minnesota	\$ 872
9	Florida	\$ 851
10	Pennsylvania	\$ 821
11	Wisconsin	\$ 743

Data Source: U.S. Department of Commerce via Global Trade Information Service. Inflation adjusted with U.S. Bureau of Labor Statistics, CPI-U.
Analysis: MN DEED and Collaborative Economics.

In water technology exports per capita, Minnesota was third nationally with about \$160 in exports per person in 2014 (Figure 12). This put Minnesota behind only Texas and Delaware in water technology exports per capita, and above the Midwest and U.S. average.

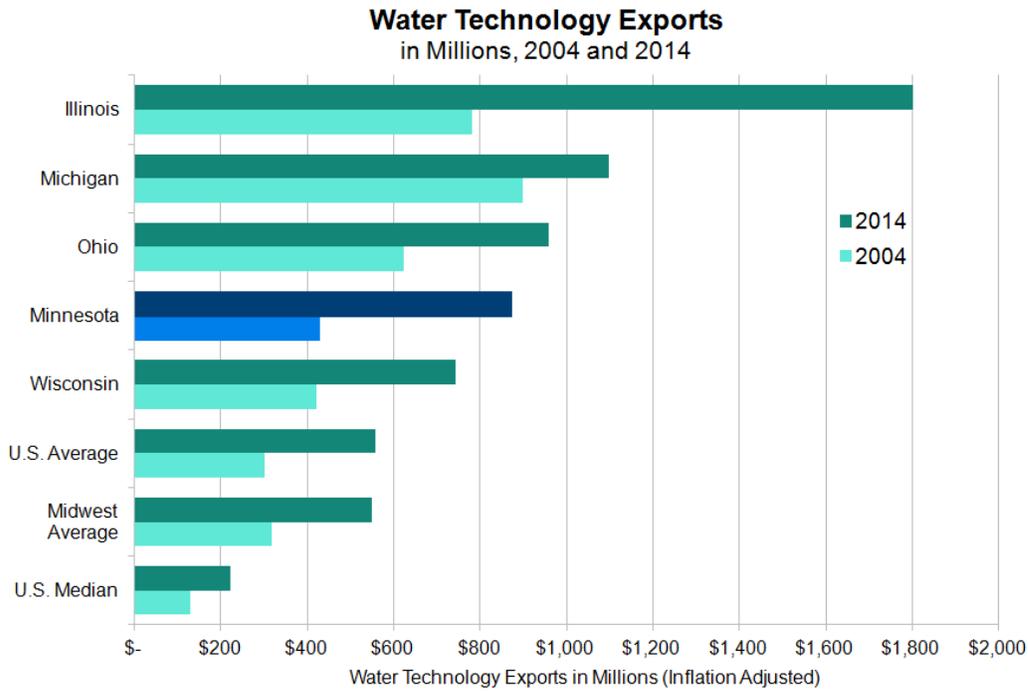
Figure 12



Data Source: U.S. Department of Commerce via Global Trade Information Service. Inflation adjusted with U.S. Bureau of Labor Statistics, CPI-U.
 Analysis: MN DEED and Collaborative Economics.

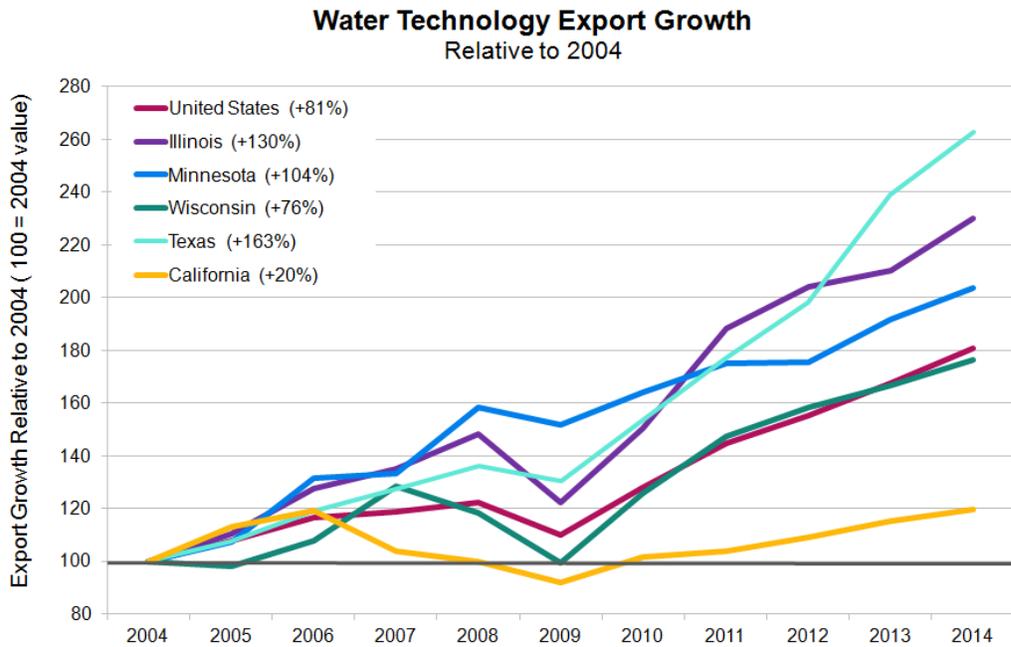
In total water technology exports, Minnesota ranked above many Midwestern states and the U.S. average (Figure 13). Exports grew across the nation between 2004 and 2014, with exports in Minnesota more than doubling (Figure 14). Texas and Illinois were among the fastest growing water technology exporters in the U.S., while other large exporters such as California had only modest growth.

Figure 13



Data Source: U.S. Department of Commerce via Global Trade Information Service. Inflation adjusted with U.S. Bureau of Labor Statistics, CPI-U.
 Analysis: MN DEED and Collaborative Economics.

Figure 14



Data Source: U.S. Department of Commerce via Global Trade Information Service. Inflation adjusted with U.S. Bureau of Labor Statistics, CPI-U.
 Analysis: MN DEED and Collaborative Economics.

PUBLIC POLICIES STIMULATING THE WATER INDUSTRY

Minnesota Water Policies

Minnesota, with nearly 12,000 lakes, the headwaters of several major rivers, and shoreline on the world's second-largest freshwater lake, has a unique relationship with water. This abundance prompted original policies and institutions to protect this special resource and leverage this local strength to grow the economy. Minnesota's policies and programs support the state's water industry by increasing demand, removing barriers and setting standards. For example, the state is in the process of updating its plumbing codes to a higher efficiency standard, and new local water plans are encouraging implementing technologies to improve efficiency and reuse. This report does not fully review the state's water quality policies, but will discuss some of the legislatively mandated funding sources that lend a competitive advantage to Minnesota.^{12 13}

In 2008, Minnesota voters established one of the state's primary water policies, the Clean Water, Land and Legacy Amendment (Legacy Amendment). The Legacy Amendment created a

**Funding in Action:
Legacy Amendment Project**

In 2011, the city of Paynesville received a \$2.5 million grant to undertake a joint project with area farmers in which wastewater effluent from the city replaced groundwater in the irrigation of cropland. The total project cost \$5.9 million and saved 267 million gallons drawn annually from regional aquifers.

central source funding to protect drinking water sources and natural resources, through an increase in the state sales tax by three-eighths of one percent beginning on July 1, 2009 and continuing until 2034. A third of the sales tax revenue from this amendment goes to the Clean Water Fund, to protect, enhance and restore water quality in lakes, rivers and streams and protect groundwater from degradation. From fiscal years 2010-2015, over \$535 million was allocated to the Clean Water Fund.¹⁴

Minnesota also funds water-related research through two main programs: the LCCMR and MnDRIVE. The LCCMR is a permanent, voter-approved fund that provides a long-term source of money for research and innovative activities that protect and enhance Minnesota's environment and natural resources for public benefit. Since 1991, the LCCMR, through the Environmental and Natural Resources Trust Fund, has provided more than \$500 million for over 1,000 projects throughout the state, including water resource-related research.¹⁵ The Minnesota Legislature authorized MnDRIVE in 2013 with \$36 million. MnDRIVE's Environment program currently focuses on developing technologies around bioremediation to solve water quality and environmental challenges. This report discusses LCCMR and MnDRIVE in detail in the Education and Research section.

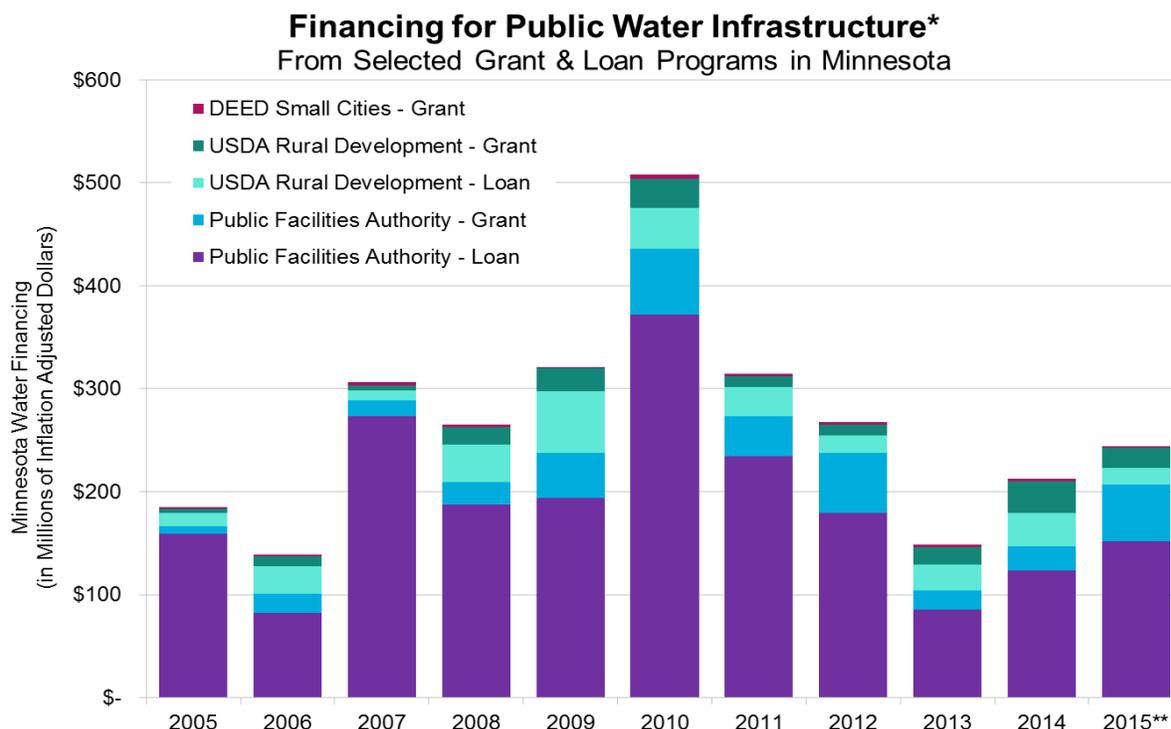
Policies that promote abundant, clean drinking water will become more relevant as water becomes scarcer. Having abundant water is a major competitive advantage for attracting and retaining business. Moreover, these water policies—and accompanying financing—offer current Minnesota companies markets for new products. Once developed, local firms can export these products and services to other states and countries. In this way, demand conditions contribute to the state's competitive advantage.¹⁶

Public Financing for Water Infrastructure

Financing for water infrastructure comes from a variety of private and public sources. This infrastructure investment, among other things, helps spur water industry growth by creating demand conditions for water products and services. Funding for capital water projects goes to preserve, expand or improve the quality of infrastructure such as water systems for treatment, distribution and/or storage, water wells, drinking water, and stormwater or sewer lines.

Public financing for water infrastructure in Minnesota is from multiple state and federal sources. The primary source of public financing for water infrastructure is the Minnesota Public Facilities Authority (PFA) through loan and grant programs. Additional sources include local/regional governmental financing and improvements through current fee income (aka pay-as-you-go); the U.S. Department of Agriculture (USDA) Rural Development program; and the DEED Small Cities Development Program.¹⁷ Between 2005 and 2015, these programs awarded a total of about \$2.9 billion in financing for water infrastructure, or an average of \$265 million annually (Figure 15). The 2010 spike in financing was due to an influx of federal American Recovery and Reinvestment Act funding and increased loan demand from localities in an effort to create jobs. An average of 80 percent of this financing was in the form of loans to cities and utilities. Of the three sources discussed, PFA's revolving loan accounted for nearly three-fourths of the total.

Figure 15



*Note: Financing is for city/utility capital projects that preserve, expand, or improve the quality of infrastructure such as water systems for treatment, distribution, and/or storage, water wells, drinking water, and stormwater or sewer lines. Data is in fiscal years.

**USDA 2015 amount only through March 2015.

Data Source: Minnesota Public Facilities Authority, MN DEED, and U.S. Department of Agriculture
Analysis: Collaborative Economics

City and regional utilities also invest in water infrastructure. Capital projects help preserve infrastructure quality, expand system capacity and improve system efficiency. The Metropolitan Council's Environmental division, for example, pays for capital improvements through Public Facilities Authority loans, grants, user fees and Met Council bonds. From 2015 to 2020, Metropolitan Council projects \$720 million in wastewater capital expenses.¹⁸ In 2015 alone, the Metropolitan Council has a \$163 million capital budget for wastewater projects.

In addition to these outlays, Minnesota cities and special districts (such as sewer, sanitary, conservation and watershed districts) had more than \$360 million in water and sewer outlays in FY 2013.¹⁹ These capital outlays were for projects ranging from equipment replacement to major construction and rehabilitation of water and wastewater treatment/reclamation facilities, water and sewer lines and stormwater management. Ninety-five percent of the total was from the local governments' enterprise funds, which are financed primarily by user fees and bonds.²⁰ The remaining 5 percent came from Governmental Funds.

Over the next 20 years, Minnesota needs more than \$7.3 billion invested in drinking water infrastructure alone, for treatment and for transmission and distribution.²¹ This investment creates a market for local water companies to provide products and services, as well as a job growth and training opportunity. However, at current funding levels Minnesota will likely fall short of this investment need.

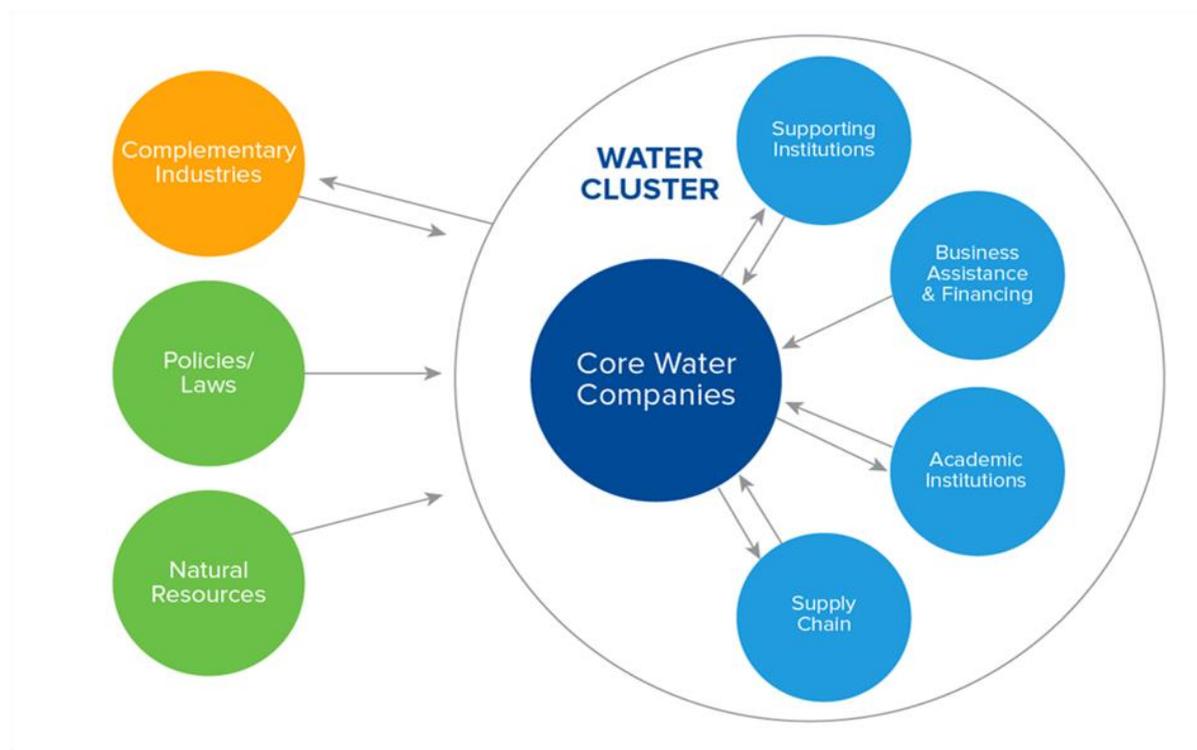
GROWING THE WATER CLUSTER IN MINNESOTA

A cluster is a grouping of related sectors focused in a geographic location that combines factors such as companies, research institutions, public organizations, specialized talent and local assets. This geographic clustering can create a powerful mechanism to increase productivity, transfer and leverage knowledge to foster innovation, share skills and experience to improve commercialization of products, and increase market specialization. Cluster formations are often a byproduct of complementary industries, local demand, laws, natural endowments, historical quirks and revolutionary companies. For example, Silicon Valley sprang out of the defense and semiconductor industries, Detroit had Ford, and filmmakers flocked to Hollywood to avoid motion picture patent enforcement. By encouraging clusters rather than focusing on individual firms, a region can increase its competitiveness, drive innovation, produce tradable products and services, and create workforce opportunities

Minnesota has a strong core water industry that grew three times faster than the state overall in the last decade. This growth is due, in no small part, to the state serving as the headquarters for several of the world's leading water industry companies, as well as prominent complementary sectors such as the region's life sciences and biotechnology sector that has related research and food and agriculture sectors that demand water products. In addition, in recent years, water industry leaders are increasingly engaging with each other and public partners to discuss how to grow the state's water industry. These dynamics, along with other factors described in this report, indicate an emerging water cluster in Minnesota (Figure 16).

Figure 16

Elements of Minnesota's Water Cluster



This cluster activity could help drive economic development and address the state's future water quality and quantity concerns. Companies in the state are globally competitive in industrial and energy water management, membrane technology and water reuse. Minnesota's lakes and rivers make it ideal for complementary industries such as agriculture and food manufacturing. The state's policies, programs and universities help support the cluster and stimulate demand.

Given this confluence of factors, what are some specific opportunities and requirements for the state to transition from an emerging to established water industry cluster? This analysis is not a comprehensive review of the Minnesota water cluster, but provides an overview of the cluster. The section ends with a review of the state's strengths and opportunities, as identified by recent surveys.

State, Regional and Academic Support for Minnesota's Water Cluster

State, regional and academic organizations are making strides to develop policies and programs to support Minnesota's emerging water cluster. Minnesota DEED, in addition to its traditional role of business recruitment and workforce development, organizes events to connect water industry partners and stakeholders. DEED hosted its first annual Water Technology Business Summit in 2014, which included 150 participants talking about the importance of growing the industry and working together to build the cluster in the state. DEED is continuing to work with industry stakeholders and programs such as MnDRIVE to grow the state's water industry.

Regional organizations also support the water cluster. Greater MSP (Minneapolis Saint Paul Regional Economic Development Partnership) is a private nonprofit organization dedicated to growing the Minneapolis-St. Paul metropolitan region's economy. Greater MSP identified the water industry as one of its key industries in the region and coordinate with stakeholders to improve the region's competitiveness.

At the center of all successful cluster efforts are excellent universities. These institutions create a virtuous cycle to advance talent, research and development, commercial knowledge and industry growth. The University of Minnesota, by making academic research accessible to companies, can be the key catalyst to move Minnesota from an emerging to an established water cluster. The University is improving connections with companies through programs such as MnDRIVE. For more information, see the Education & Research section of this report.

"A university focused on water research...is going to be absolutely critical to catalyze this [cluster], but that research has to become really available and very easily accessed by companies."

- Doug Baker, Chairman and CEO of Ecolab, Sept. 30, 2014, at UMN conference

There is still much work to do to improve the region's cluster environment. In recognition of this need, the state has reached out to water-related businesses and organizations to gather ideas.

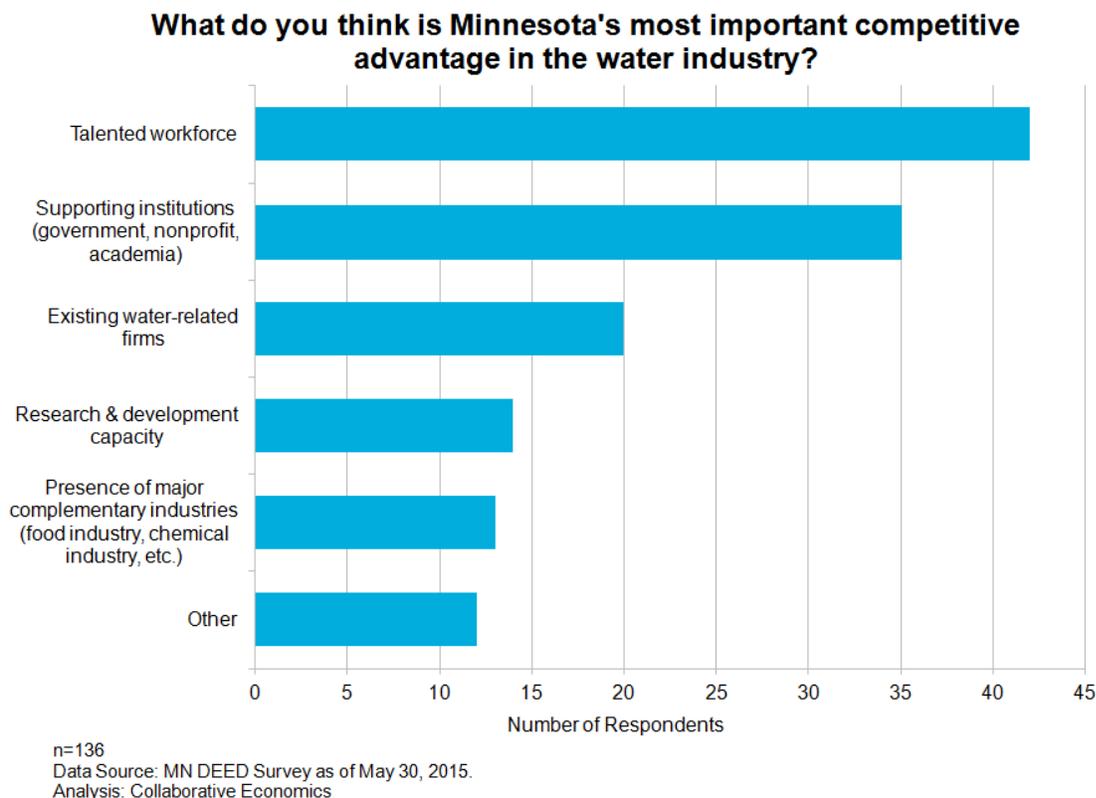
Minnesota Cluster Opportunities – Survey Results

This section presents survey results from water companies in Minnesota regarding strategies to grow the cluster, as well as cluster strengths and challenges. These surveys and conversations with industry stakeholders are informing policy makers and prioritizing industry development efforts. The state surveyed water companies twice in the last year. One survey in March 2014 drew from attendees of the Minnesota Water Technology Business Summit; DEED issued the other survey to companies in May 2015 to gather data for this report.

Minnesota's Competitive Advantage in the Water Industry

DEED survey respondents identified a variety of factors that provide the state a competitive advantage in the water industry (Figure 17). Respondents could choose only one option, and no one category received a majority. A plurality of respondents (31 percent) identified the state's talented workforce as the most important competitive advantage, followed by supporting institutions like government and academia (26 percent), and existing water-related firms (15 percent). This indicates that water-related education and supporting institutions are doing well at creating a supportive industry environment and should continue efforts to improve the state's competitive advantage.

Figure 17

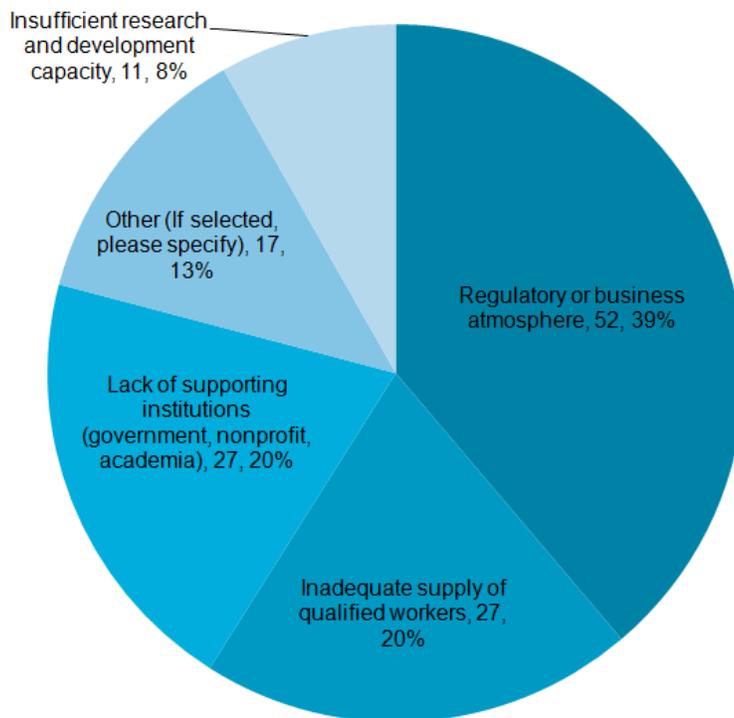


Barriers to Growth in the Minnesota Water Industry

DEED survey respondents identified several barriers to water industry growth in Minnesota. Respondents could choose only one option, and most respondents noted the regulatory or business atmosphere as a barrier to growth (39 percent) (Figure 18). This indicates that policy makers should work with industry to identify actions to reduce regulatory hurdles and encourage business growth. In addition, in the “other” category, respondents noted regulatory and business barriers such as overlapping and complex regulations, high corporate taxes, a lack of investment incentives, and that cheap water may actually discourage investment. About 20 percent identified an inadequate supply of qualified workers, and another 20 percent identified a lack of supporting institutions as the greatest barrier to growth. Only 8 percent of respondents thought insufficient research and development capacity was the greatest barrier to growth, though other DEED-led forums have indicated a need in this area.

Figure 18

In your opinion, what is the greatest barrier to water industry growth in Minnesota?



n=134
Data Source: MN DEED Survey as of May 30, 2015.
Analysis: Collaborative Economics

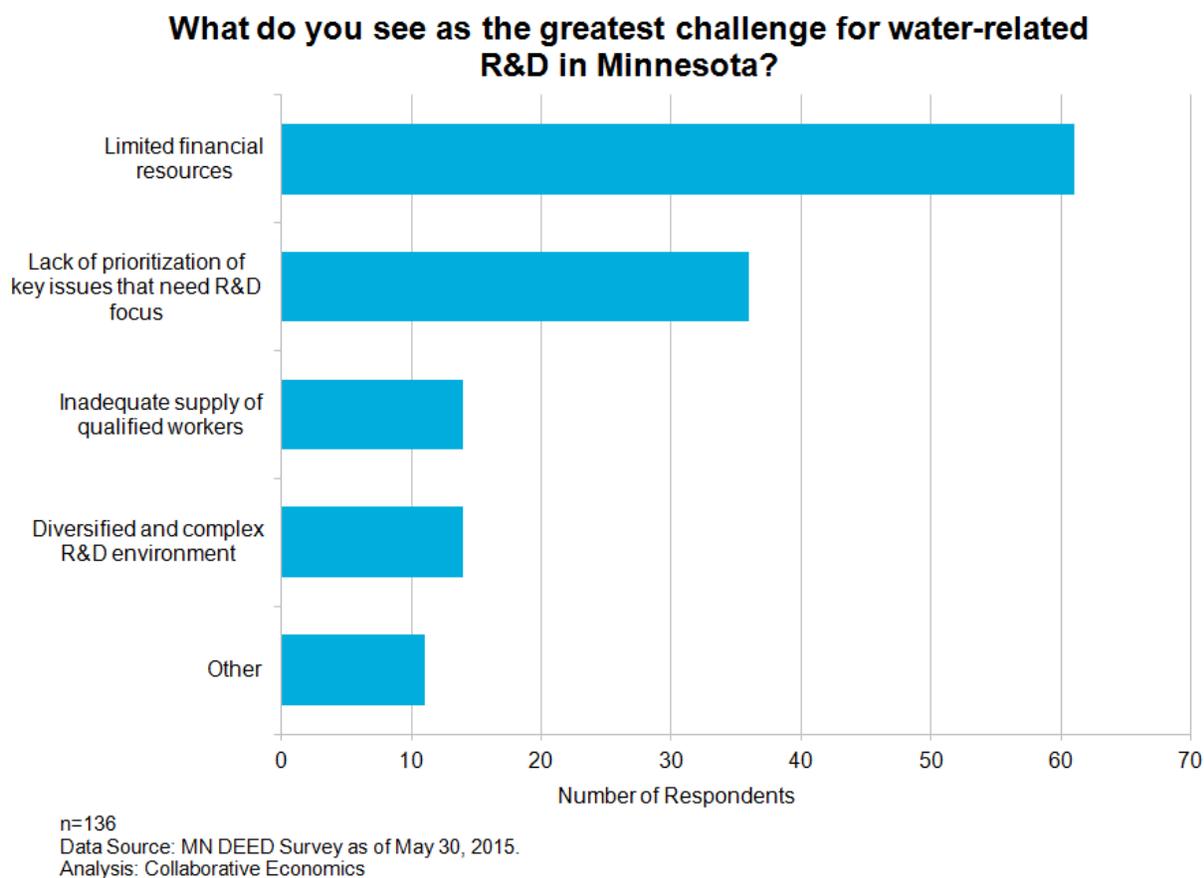
Research and Development Challenges in Minnesota's Water Industry

As noted in previous sections, many water companies seem to be interested in water research, particularly with the University of Minnesota. Therefore, the DEED survey also asked what respondents thought was the greatest challenge for water-related research and development (R&D) in Minnesota (Figure 19).

Most respondents (45 percent) noted limited financial resources are the greatest challenge for water-related R&D. While the state does have some policies that provide water-related research funds such as LCCMR and MnDRIVE, the Innovation section of this report also illustrated that early-stage investment for water-related technology companies is lacking.

About 26 percent identified a lack of prioritization of key issues that need research focus as a challenge. Just above 10 percent of respondents thought the R&D environment was too diverse and complex, while another 10 percent thought the greatest challenge was an inadequate supply of qualified workers.

Figure 19



Strategies to Grow the Minnesota Water Cluster

In addition to identifying challenges and barriers, both surveys identified opportunities to address these challenges and grow the water cluster in the state. By focusing on a cluster rather than individual firms, a region can increase productivity, foster innovation and increase market specialization. The Water Summit, in particular, focused on the importance of the growing water industry, identifying ways to work together to build the cluster, and how Minnesota companies can be global leaders in providing solutions. Growing and improving Minnesota's emerging water cluster could help drive economic development and address the state's water quality and quantity concerns in the future.

DEED survey respondents and Summit attendees were most keen on finding strategies to increase collaboration with local universities. For example, university collaborations could provide students with exposure to and practical experience in the industry. In addition, increased collaboration could increase opportunities for businesses and entrepreneurs to commercialize new technologies developed by academic researchers.

Most of the Summit survey respondents thought an annual conference and networking events would help the industry. More than half of DEED survey respondents also identified this as an effective strategy. These types of events are occurring more frequently, but could be more regular to help spread novel ideas, create connections between entrepreneurs, firms and researchers, and identify opportunities for public and private partners to work together to grow the cluster.

In addition, Summit survey respondents thought a water industry cluster organization would be beneficial. DEED survey respondents echoed this view, with 46 percent saying a water association to centralize industry activity would be an effective approach for expanding the industry. For example, a cluster organization could help foster partnerships between companies to demonstrate or incubate new technologies, help new companies with intellectual property needs, and highlight the region as a water industry hot spot to attract more firms and workers. More work needs to be done to articulate the vision and activities of a potential state water cluster organization.

Summit survey respondents identified several strategies related to improving branding, marketing and international outreach of the region's water cluster. For example, the cluster could create a brand identity, increase publicity and targeted messaging to stakeholders, and partner with international organizations to promote the cluster worldwide. DEED survey respondents, in contrast, were neutral on the effectiveness of this strategy.

These strategies point to tangible actions stakeholders can take to strengthen the cluster. In addition to these suggestions, Minnesota can look to other regions for lessons and strategies to grow the water cluster.

Examples of Other Water Industry Clusters

Other regions are organizing around water clusters to solve local and global challenges and grow their economies. These regions provide lessons and strategies for organizing and growing the cluster. These regions are still early in their business engagement and/or have a different focus, indicating there is ample room for Minnesota to become a leader. These case studies offer a sample of regional activities, not a comprehensive overview of all water cluster activity.

San Joaquin Valley, California

The San Joaquin Valley is a fertile agricultural hub in the center of California with a prominent food manufacturing sector, but water is a major concern in the region because of an ongoing drought. San Joaquin Valley launched a water cluster in 2001 to leverage this concern as an economic development opportunity. It is considered the first water cluster in the nation. Known as Blue Tech Valley, the cluster is driven by industry, with support from academia and the community. Its initial goals were to develop a skilled workforce, accelerate water technology innovations and improve trade. Today it has 150 member companies driving the cluster and expanding water innovations. The Valley has continued to develop a number of connected initiatives under the Blue Tech Valley umbrella to promote local development and implementation of water and agriculture efficiency technologies. These initiatives are primarily centered in the city of Fresno and based out of California State University-Fresno.

The [Water Energy Technology Center \(WET Center\)](#) is the Fresno-based physical facility for the water cluster, with on-site testing facilities and an incubator that is working to support local innovation and businesses. The WET Center was established in 2007 as a partnership between the nonprofit Central Valley Business Incubator (CVBI), the [International Center for Water Technology \(ICWT\)](#) and California State University-Fresno to accelerate growth in the water, energy and agriculture technology sector. The WET Center has three testing facility buildings on Fresno State's campus, including the [Center for Irrigation Technology \(CIT\)](#), a hydraulic testing center and air testing facility, in addition to on-site crop production sites that allow for field testing.

Israel

Israel has been at the forefront of water irrigation and conservation technologies, driven by its limited access to freshwater and arid climate. The country has leveraged its research and technology strengths to turn its water shortage into a surplus, while building its water industry. Israel is now a leader in desalination efforts, as well as recycling and reusing wastewater for agriculture.

The [Israeli government](#) established the Water Authority to lead the operation and development of its water economy. It also formed NEWtech, the network of government ministries, including health, agriculture and education, to support Israeli water companies in exporting their technologies to other regions. Israel now has a number of incubators and early-stage water companies developing new technologies, as well as a highly skilled labor pool in the water industry. Israel also started an international [Water Technology & Environment Control Exhibition & Conference \(WATEC\)](#), now in its fifth year, to bring together Israeli and international businesses, utilities, researchers and political leaders. This conference allows the country to showcase technologies and solutions and highlight Israel's leadership in the water industry.

Greater Cincinnati, Ohio

Greater Cincinnati, Ohio, is the center of water technology research in the region. Leveraging assets from nearby areas, Cincinnati has joined forces with northern Kentucky and southeastern Indiana to form a tri-state water technology cluster. This cluster grew out of a government evaluation of regional assets, such as the U.S. Environmental Protection Agency's (EPA) water research center, that could be harnessed to develop a water technology innovation cluster. The region embraced the results of this cluster research as a way to encourage regional economic development and in 2011 formed [Confluence](#) as a nonprofit entity to ensure the success of the cluster.

The regional cluster is tapped into the EPA's water research center located in Cincinnati and works with local companies to accelerate commercialized technologies developed at the research center. The cluster has broken out into a number of work groups. One of the groups is a Confluence Partnerships Team, whose goal is to build mutually beneficial relationships with businesses and organizations around the world around water technology. Another group is the Protocol and Test Bed group that is working to develop an agreed-upon protocol for testing and approving water devices. A third group, the Business Advocacy Council, works to create linkages between the water technology producers (e.g., entrepreneurs, inventors and small businesses) and the water technology companies, utilities and users.

Milwaukee, Wisconsin

The Milwaukee region is strategically located along Lake Michigan in Wisconsin and has major operations for companies such as Johnson Controls, A.O. Smith Corporation, and wet industries from beer and other beverages. Milwaukee is quickly building itself into a water hub. The region's water cluster has been developed around companies in the sector and demand from wet industries for a more innovative and efficient use of water. Industry, researchers, individuals from the public sector and funders joined together to tackle the topic of water efficiency.

Leaders in business and education formed the [Water Council](#) in 2007, which focuses on encouraging, promoting and facilitating efficient and innovative use of fresh water resources, and is one of the world's most significant water research hubs. The council is composed of 150 water technology companies and over 100 academic scientists and researchers who are focused on water solutions. Their efforts center on water research, education and economic development, and they are developing programs to train the region's workforce. In 2013, the Water Council developed a water research and business accelerator called the [Global Water Center](#). This Center houses water-related research facilities for universities and companies and an accelerator space for emerging companies.

CONCLUSION

In the coming decades, the ability for businesses and residents to access clean water will become a major determinant of regional competitiveness and a significant market opportunity. Minnesota, with its abundant water resources, inventive companies and forward-looking policies, is primed for success. The state can use its water resources, technologies and services to grow the economy, as well as create local opportunities for the broader water-enabled industries that rely on clean and readily available water.

Minnesota's water industry includes a variety of companies and organizations that create or provide products or services to improve the use, quality and flow of water. The state's core water firms employed 13,500 workers in 2014 and grew three times faster than the state's overall employment in the last decade. Minnesota workers in the water industry brought home over \$885 million in wages in 2014, in jobs that paid average wages well above the state average. Minnesota's strong colleges and universities also bolster the state's water industry workforce. Businesses are advancing innovation in water technologies, and Minnesota companies rank among the top 10 in water technology patents nationally.

By encouraging clusters rather than focusing on individual firms, a region can increase its competitiveness, drive innovation, produce tradable products and services, and create workforce opportunities. Minnesota's strong and stable industry and assets give the state an opportunity to grow its water cluster, but Minnesota is not the only state with significant competitive advantages in water. Other regions, states and countries have recognized the outsized opportunity and are investing heavily in their own clusters. To capture the growing market opportunity, Minnesota needs to mobilize quickly around strategies to grow its cluster. Public and private stakeholders in the water industry identified several approaches to grow the cluster, such as:

- Increase collaboration among firms and researchers to apply research to solve industry challenges and commercialize new technologies;
- Create a water cluster organization—comprised of companies and supporting institutions—to foster partnerships, incubate new technologies, pursue federal grants and private investment, and attract water firms, investors and workers;
- Increase the frequency of water conferences and networking events to help spread ideas and create connections between entrepreneurs, firms and researchers; and
- Improve branding and marketing of the cluster by increasing publicity and sharing the region's successes locally, regionally and globally.

In many ways, this emerging water cluster is similar to the early days of Minnesota's medical device industry. This established cluster grew out of complementary industries and innovative medical companies and emerged at a time of growing global demand. Medical devices are now a major contributor to a vibrant state economy. The water industry—under the right conditions and with the proper nurturing—could have a similar impact on the prosperity of future Minnesotans.

APPENDIX

Employment Data Methodology

Collaborative Economics has developed a multifaceted approach for identifying and tracking the growth of businesses with operations primarily in the core water industry. This methodology was originally developed for work carried out on behalf of Next 10, a California-based nonprofit, and published in the *California Green Innovation Index* and *Many Shades of Green* (2008, 2009, 2010, 2012, 2013 and 2014). It was enhanced and revised in conjunction with Minnesota Department of Employment and Economic Development (DEED) databases and analysis.

Constructing the MN water industry employment database involved multiple data sources. To identify the potential water businesses, Collaborative Economics, in coordination with the state and industry stakeholders, developed a list of standard industrial classification (SIC) and North American Industry Classification System (NAICS) codes likely to include at least some water companies, drawing on water industry jobs and technology literature, as well as independent review of the industry code. In addition to these industry codes, Collaborative Economics identified specific companies active in the water industry, leveraging multiple data sources, including records of water investments (e.g. Cleantech Group), industry associations or event attendee lists (e.g. MN Water Technology Business Summit), media sources, and Minnesota's prior research and industry engagement efforts.

Using the 2012 National Establishments Time Series (NETS) database, Collaborative Economics leveraged the industry codes and company lists to identify specific core water industry establishments within Minnesota. The NETS database was developed by Walls & Associates, based on Dun & Bradstreet business-unit data and represents a census of jobs and establishments. The Institute for Exceptional Growth Companies (IEGC) at the University of Wisconsin Extension Division of Entrepreneurship and Economic Development provided 2013 and 2014 employment data, which was appended to the 2012 NETS database by Collaborative Economics. IEGC assembled, verified and, where necessary, updated Dun & Bradstreet data for latest full calendar year rolling through each current quarter. To produce and verify the current year dataset, IEGC goes back through the NETS data to verify and update any information where the current data requires changes.

Through both automated and manual verification of these establishments, Collaborative Economics identified companies from within the potential list of companies that conducted a majority of their business activities in the core water industry, and assigned an appropriate water segment. Identification and review of companies focused on establishments with employment in 2012-2014. A full analysis of companies that may have been active in earlier years (e.g. 2004) and closed before 2012 is therefore not included. In cases where the results were uncertain and the activities of a business establishment could not be verified (e.g. on a company's website, through public record), the establishment was not included. Therefore, the analysis offers a conservative tracking of jobs in the core water industry.

The jobs numbers reported in the database reflect all jobs at each vetted business location for which a majority of the business operations are in the water industry. In the case of multi-establishment companies, only the water establishments are included.

To further refine and tailor Minnesota's core water industry jobs database, DEED issued a survey to businesses potentially in the water industry regarding employment and revenue activity in each sector. Collaborative Economics used the survey results to identify additional establishments and to apportion more specific levels of employment within companies to the water industry. Establishments that reported water industry employment at significantly different levels from the NETS/IEGC data were cross checked with DEED databases and, if appropriate, employment was adjusted and/or deflated over time at the average growth rate of the companies' respective water industry segment. About 9,000 emails were sent (including to multiple people within a company). As of May 30, 2015, 285 companies responded to the survey. After duplicate company responses were removed, a total of 211 companies provided usable employment information included in the final analysis.

Regional analysis uses the seven Minnesota Initiative Foundation regions. These regions are larger groupings of the 10 economic development regions serviced by the state's Department of Employment and Economic Development.

Wage Data Methodology

DEED's Economic Analysis Unit conducted wage analysis using establishments identified in NETS/IEGC (described in employment methodology above) and Minnesota's unemployment insurance (UI) records. Minnesota's UI record database is a joint effort of DEED and the Bureau of Labor Statistics. Researchers linked firms from the NETS database to DEED's UI records by a manual review process. This data set is comprised of data reported by employers as part of unemployment compensation filings (ES-202 Program). In doing so, DEED staff were able to link 89 percent of employment identified by NETS to an employer over the period. The firms researchers were unable to identify, tended to be small (<five employees) and recently founded. This finding is consistent with academic critiques of differences between NETS and the ES-202 program.²² The NETS employment and UI average wage per worker were combined to get total payroll. Where necessary, outliers were smoothed to ensure consistency between the two sources.

In the 11 percent of cases in which researchers were unable to link a NETS employer to the UI database, the research team used the average wage rate and multiplied by the remaining NETS water industry employees by segment, and added to water industry total wages.

All wages were adjusted for inflation using the U.S. city average Consumer Price Index of all urban consumers, published by the Bureau of Labor Statistics. Note that while 2014 wages cover the entire calendar year, employment from NETS/IEGC is only through first quarter 2014.

Occupations

Water-related occupations were based on Greater MSP's [watertech](#) industry brochure. Occupation data, including location quotient and average annual wage, are from the U.S.

Bureau of Labor Statistic's Occupational Employment Statistics, as of May 2014. The typical education needed for entry is based on the 2012 National Employment Matrix and is not Minnesota-specific.

Early Stage Investment in Water Technology

Investment data are provided by Cleantech Group's i3 database and includes disclosed investment deals in private companies. Data is through December 2014. All figures were adjusted for inflation using the U.S. city average Consumer Price Index of all urban consumers, published by the Bureau of Labor Statistics.

Early Stage investment data includes venture capital (Angel, Seed, Series A-E+, Growth Equity) and federal grants. Data on Small Business Innovation Research grants for water technology were provided by the U.S. Environmental Protection Agency's Environmental Technology Clusters Program in May 2015. Merger and acquisition data is also from Cleantech Group and include water companies either located in Minnesota or purchased by a company headquartered in Minnesota.

Water Technology Patents

Water Technology Patents are sourced from IP Checkups through the CleanTech Patent Edge™ database, which includes water technology patent data including published patent applications from the U.S. Patent and Trademark Office (USPTO). Patent counts by state included in this analysis reflect the location of the first named inventor, and companies reflect first assignee name at time of patent publication.

IP Checkups classifies patents into water technology based on patent classification codes and key word searches. Some patents fell into multiple segment and sub definitions, and if these segments were equally applicable – as defined by IP Checkups and Collaborative Economics – a patent was termed "multiple." Segment names from IP Checkups adjusted slightly to match the core water industry segment definitions used in the employment analysis.

Population data for the per capita analysis are from the U.S. Census Bureau, Population Division.

Water Technology Exports

Water technology export data are from U.S. Department of Commerce via Global Trade Information Service, 2015. The data are based on harmonized system codes using the water technology export definition from Environmental Technologies Trade Advisory Committee, U.S. Department of Commerce, 2012. Data are adjusted for inflation using the U.S. city average Consumer Price Index of all urban consumers, published by the Bureau of Labor Statistics.

Public Water Infrastructure Financing

Data on public financing for water infrastructure are from three sources: the Minnesota Public Facilities Authority, the U.S. Department of Agriculture (USDA) Rural Development program, and the DEED Small Cities Development Program. An average of 80 percent of this financing was in the form of loans to cities and utilities, with the remainder as grants. Data are shown by

fiscal year and adjusted for inflation using the U.S. city average Consumer Price Index of all urban consumers, published by the Bureau of Labor Statistics.

Cluster Opportunities Survey Results

To learn more about opportunities and strategies to advance Minnesota's water industry, DEED issued a survey to businesses potentially in the water industry regarding employment and revenue activity in each sector (Exhibit C). While this survey was primarily to gather jobs data, its secondary purpose was to learn more about the state's water industry. About 9,000 survey emails were sent (including to multiple people within a company). As of May 30, 2015, 285 companies responded to the survey. After duplicate company responses were removed, a total of 211 companies provided usable employment information included in the final employment analysis.

Collaborative Economics used the DEED survey results for the report section Minnesota Cluster Opportunities – Survey Results. Of the companies included in the analysis from the DEED survey, the number of responses in each question ranged from 85 to 144. Note that about two-thirds of the DEED survey respondents were public water utilities, which are less export-oriented businesses. There may be overlap in respondents to these surveys.

The subsection on Strategies to Grow the Minnesota Water Cluster also included survey results from attendees of the March 2014 Minnesota Water Technology Business Summit. The survey was sent out via email, followed by three reminders. Sixty-four of the 147 people who attended the event responded to at least the first question, for a response rate of 44 percent. About 12 of these responses were blank after the first question, for an adjusted response rate of 35 percent.

ENDNOTES

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- ¹ United Nations. "Water Scarcity Factsheet." 2013. <http://www.unwater.org/publications/publications-detail/en/c/204294>
- ² Minnesota Department of Natural Resources. "Lakes, Rivers, and Wetland Facts." 2013. <http://www.dnr.state.mn.us/faq/mnfacts/water.html>
- ³ United Nations. "Water Scarcity Factsheet." 2013. <http://www.unwater.org/publications/publications-detail/en/c/204294>
- ⁴ Stiehler, Alexander. "Longer Term Investments- Water Scarcity" July 2015. UBS.
- ⁵ Minnesota Department of Natural Resources. "Lakes, Rivers, and Wetland Facts." 2013. <http://www.dnr.state.mn.us/faq/mnfacts/water.html>
- ⁶ Minnesota Department of Employment and Economic Development. "Area Definitions - Economic Development Regions." Accessed June 2015. <https://apps.deed.state.mn.us/assets/lmi/areamap.shtml>
- ⁷ The average annual wage according to the Bureau of Labor Statistics' Occupational Employment Statistics is \$48,300 for May 2014. However, the average annual wage of \$51,600 for 2014 from the Quarterly Census of Employment and Wages is used to be consistent with the wage analysis in this report.
- ⁸ Lombardi, John V. et al. "The Top American Research Universities, 2012 Annual Report." 2012. The Center for Measuring University Performance. <http://mup.asu.edu/research2012.pdf>
- ⁹ Coss, Kevin. "Partnership creates eco-friendly method to clean mine water." June 11, 2014. Inquiry. The University of Minnesota. <http://inquiry.research.umn.edu/2014/06/11/u-industry-partnership-creates-eco-friendly-method-to-clean-mine-water/>
- ¹⁰ Coss, Kevin. "Startup Profile: Minnepura Technologies Inc." May 13, 2015. Inquiry. The University of Minnesota. <http://inquiry.research.umn.edu/2015/05/13/startup-profile-minnepura-technologies-inc/>
- ¹¹ Global CONNECT. "Integrating and Enhancing the BC Knowledge Transfer System." May 2007. <http://globalconnect.ucsd.edu/reports/documents/BritishColumbiaAVED-BCICFinalReport.pdf>
- ¹² The Water Industry Economy Profile is a section in the Environmental Quality Board's Five-Year Minnesota Water Report. For a more detailed look at policies governing water quality and quantity, reference this document.
- ¹³ Other conservation, management, monitoring, technical assistance and planning grants come from Board of Water and Soil Resources, the Department of Natural Resources, Department of Agriculture, Department of Health, Pollution Control Agency, Lessard-Sams Outdoor Heritage Council, and federal agencies and local units of government. Much of grant money administered by agencies comes from the Clean Water Fund.
- ¹⁴ Minnesota State Legislature. "Clean Water & Legacy Amendment." Accessed June 2015. <http://www.legacy.leg.mn/>
- ¹⁵ Minnesota State Legislature. "Legislative-Citizen Commission on Minnesota Resources." Accessed June 2015. <http://www.lccmr.leg.mn/>
- ¹⁶ In the Competitive Advantage of Nations, Michael Porter discusses how "demand conditions" or sophisticated and demanding local needs can lead to competitive advantages and clustering. Areas that are able to develop a competency in product or service earlier than the rest of the world are able to export those goods. For example, early adoption of water quality standards could induce local producers to develop new technologies to treat and reuse water. As other regions adopt these standards, local producers can export their knowledge to later adopters.
- ¹⁷ Other federal and state entities, such as the Army Corps of Engineers, Minnesota Department of Health and the Board of Water and Soil Resources, provide infrastructure funding. This funding tends to be more intermittent or with conservation and technical assistance as part of a holistic effort to improve water quality. Much of the state agency grants are from the Clean Water Fund.

¹⁸ Metropolitan Council. Discussions with staff from Metropolitan Council, as well as the “2015 Unified Budget.” Adopted 12/10/2014. <http://www.metrocouncil.org/METC/files/26/266d8549-0c0d-4b94-ac35-13e4428657fd.pdf> and the “MCES Capital Program.” <http://www.metrocouncil.org/Wastewater-Water/Funding-Finance/Budgets/Budget.aspx>

¹⁹ Office of the State Auditor. Discussions with staff from the Office of the State Auditor, as well as “Minnesota City Finances: 2013 Revenues, Expenditures, and Debt.” 2015. http://www.auditor.state.mn.us/reports/gid/2013/ciRed/ciRed_13_Report.pdf

An Enterprise Fund is established to account for operations financed and operated in a manner similar to private business. The debt service on bonded and other long-term debt related to the enterprise fund are generally recovered through user fees from the customers of the service although grants from other levels of government may pay for part of the debt.

²⁰ The Metropolitan Council is also a special district whose capital outlays are part of the enterprise fund. In FY 2013, the Environmental Services division had \$124 million in sanitation-related capital outlays. This was omitted from the special district total to prevent confusion and double counting of the other capital outlays discussed in the section.

²¹ U.S. Environmental Protection Agency. “2011 Drinking Water Infrastructure Needs Survey and Assessment.” Released April 2013. http://water.epa.gov/grants_funding/dwsrf/upload/epa816r13006.pdf

²² Kunkle, G. (2011). Business Establishment Employment Data: Nets Versus Es-202. *Edward Lowe Foundation's Institute for Exceptional Growth Companies*. Retrieved from: <http://exceptionalgrowth.org/insights/NETSvsES-202.pdf>