# UPSTREAM ILLINO Strategies to Boost Illinois' Blue Economy

Anchored by Current

Prepared by RW Ventures, LLC; In partnership with Elevate, Mass Economics, and MKM Consultants

# A Blueprint for Action

# Letter from Leadership

Here in the Great Lakes, the value of water, one of our most precious resources, is often hidden in plain sight. Water fuels the

lives and livelihoods of every resident in our region. When we take it for granted, assuming that we will always be able to count on access to clean, abundant, and affordable water, we miss key opportunities to leverage our globally significant water resources to create economic opportunity for the people and places in our region that need them most.

We know, however, that **shifting global demands on limited water resources are sharpening the focus on water's economic, political, and environmental value.** As we watch other regions struggle to meet demand for water from industry and consumers, we can anticipate and better prepare for increased pressures on the precious natural resources right here in our back yards. Further, as climate migration becomes more of a reality and we begin welcoming people and businesses to our region for our relative water abundance, we must prepare to use our resources carefully and hold ourselves accountable for protecting the Great Lakes for generations to come.

At the intersection of growing demand for water and growing concern for environmental stewardship sits innovation: **novel solutions to water challenges create vital economic opportunities for the Great Lakes region and its residents.** Transformative federal



investments in infrastructure and State and local investments in clean energy and jobs are providing unprecedented resources for communities to prepare for climate futures while catalyzing job creation, entrepreneurship, patents, foreign direct investment, exports and more. Accelerated by climate change, interest in corporate water stewardship is driving demand for more and better water technologies. Illinois can harness this moment for lasting inclusive growth — meaning that the people and places most in need and most underrepresented in the water and technology clusters should be first in line to benefit from new opportunities as our Blue Economy grows. Already a \$16.7 billion industry, the Blue Economy in Illinois stands to grow even larger to meet evolving climate challenges.

This strategy is a blueprint to guide civic, nonprofit, and industry leaders towards building the kinds of innovative programs and partnerships that will **make Illinois the center of a strong, nation-leading Inclusive Blue Economy**. None of the strategies recommended in this report can be achieved by any one sector alone. The region will benefit most from cross-sector leadership uniting around a shared vision and goals to 2030, and beyond.

We invite you to join us on this journey to securing, sustaining, and stewarding our water resources to ensure the prosperity of our region and its residents. Read the full report and learn more about how to engage in implementation at **www.currentwater.org**.

Signed,

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# I. Executive Summary

VISION

By 2030, Illinois will be home to a thriving and inclusive Blue Economy where water companies, corporate water users, utilities and research institutions collaborate to develop, manufacture, and distribute nation-leading treatment and monitoring technology, catalyzing environmental solutions and inclusive economic growth.

# This strategy is a blueprint.

This strategy is a blueprint for Illinois and the Great Lakes, grounded in the Chicago region, to grow and sustain a globally significant Inclusive Blue Economy. With the right strategies in place and the right leaders at the table, we can support a greater volume of environmental and public health solutions, while narrowing opportunity gaps and centering jobs and economic growth around the people and places who have long been underrepresented and underserved. Only with leadership cross-cutting government, industry, research, and investors, will we be able to transition Illinois from a rust belt to a clean belt economy by 2030.

# What do we mean by the Blue Economy?

The Blue Economy is the collection of companies that develop and provide technologies, products and services that manage the movement, quality and use of water — in addition to inputs to make these products, supporting industries, and the customers that demand these products. (See Section III "What is the Blue Economy?" for a deeper explanation.)

# We have the building blocks.

We have the building blocks. In 2020, the water cluster (companies that develop and provide technologies, products and services that manage the movement, quality and use of water) in Illinois was a \$16.7 billion industry supporting 186,000 jobs. Illinois is third in the nation on developing sensor technology. Illinois' Blue Economy, which more broadly encapsulates the inputs and end-users of the water cluster as well, employed nearly 1.5 million people — approximately 30% of all employment in the state.

Illinois needs to take advantage of this important moment in time by leveraging our world-class resources — research institutions, incubators and accelerators, headquarters companies, and the right concentration of growing manufacturing, engineering, and data industries — to make the region a home for water innovation that solves both local and global water challenges.

# 1.5 MILLION

people employed in Illinois Blue Economy



The *Inclusive* Blue Economy seeks to fundamentally reposition disadvantaged people and places, particularly communities of color, as drivers and beneficiaries of the enormous growth opportunities in the Blue Economy.

**Inclusive growth** is achieved through ownership and entrepreneurship, employment, location and access, and participation in the Blue Economy.

Illinois, anchored by the Chicago region, can leverage local assets and promote cross-regional collaboration by:



Accelerating the commercialization of advanced treatment and resource recovery technologies,

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**Developing manufacturing and water efficiency technologies** for export to water-scarce regions,

- Expanding adoption of sensors and monitoring technologies by matching products with end-users,
- Growing and diversifying the workforce to meet employer demands for development and production of these products and services.

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6

Linking research and development strengths with manufacturing and commercialization strengths across Illinois and in the Milwaukee region,

Leveraging manufacturing strengths to supply pipes and fittings to aid increased global demand,



Products, their distinct supply chains, factor conditions, related industries, and demand conditions point to three major **opportunities**:

- 1. Treatment
- 2. Monitoring/Sensing
- 3. Infrastructure and Fixtures

and further into three emerging areas:

- 1. Data Integration in Water Systems
- 2. Water-Energy Nexus
- 3. Resource Recovery

(See **Market Analysis** section for more detail on local strengths and positioning)

# What do we need to do to build a thriving and inclusive Blue Economy by 2030?

Achieving the vision of an inclusive Blue Economy by 2030 requires city, state, and federal leaders to align around and invest in implementing the specific strategies identified below, and anchor water within existing priorities to combat climate change. It needs leaders in water-using industries (including food and beverage, agriculture, manufacturing, energy, and health and life sciences) to **recognize where water risk is hidden in their operations and supply**  chains and to be better stewards of the environment. And finally, it requires research institutions, investors, and the broader entrepreneurship-supporting ecosystem to center water innovation as a business opportunity and solve challenging barriers to commercialization.

None of this important work can be achieved alone — each of the strategies below require cross-sector collaboration:

## Industry-Led Collaboratives

To promote growth of a strong Blue Economy, enable the continuous innovation and commercialization needed to bring research to market, and build the region as a competitive global center for water-related innovation and product development.

#### **Employer-Led Workforce Development**

To reform labor market systems to be more skills-based, responsive and targeted, and designed with specific opportunities and challenges for women and people of color in mind.

#### Testing, Certification, and Demonstration Center(s)

To accelerate market integration of new products with one another and with older systems, increase pathways to certification to different water standards, and to increase opportunities for entrepreneurs to develop and pilot products.

# 4

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3

#### **Business Growth Assistance Programs**

To provide sophisticated business and finance support services to firms and entrepreneurs to enable them to scale-up their operations and grow into established companies.

#### Manufacturing Initiative

To establish a hub for manufacturers capable of manufacturing water technologies and assist in strengthening regional supply chains in the water cluster.

# LET'S GET STARTED.

# II. Introduction

## The Blue Economy: A Growing Economic **Opportunity** for Illinois



In the Great Lakes region, the ubiquity of water in our lives and its relative abundance can make it easy to take for granted. As an economic development opportunity, water as an input to supply chains, along with the needed tools, technologies, and services that improve its delivery, treatment, and use, is often hidden from view. Better management of water resources is a growing global challenge, with implications for the health of the public and the growth of industries - from food and beverage manufacturing to metal working. New environmental and economic trends are driving increasing demand for water quality and efficiency across retail, commercial and industrial users. In response, demand is growing globally for a next generation of processes, products and technologies for the cleaning, movement, and use of water.

Because of its concentration of economic assets - headquarters companies, utilities, research universities and national labs. talent - Illinois is well positioned to claim a leadership position in the production of these new products, technologies and services. However, before strategic investments can occur, Illinois needs to define its unique positioning, "right to win," and focus areas within this broader set of industries and



technologies. This paper defines the Blue Economy as:

The collection of companies that develop and provide technologies, products and services that manage the movement, quality and use of water - in addition to inputs to make these products, supporting industries, and the customers that demand these products.

An array of emerging economic and environmental trends is reshaping where and how growth is occurring in these water-related technologies and industries. For instance:

- Treatment. Continually emerging contaminants from industrial processes, agricultural runoff, pharmaceuticals and more are demanding advanced treatment technologies to keep our drinking water safe.
- Monitoring. Utilities and municipalities are investing in solutions to monitor and report on water quality in real-time.
- Water infrastructure. The infrastructure for delivering water and disposing of wastewater is generally aging and, in some places, inadequate to meet demand. Large federal investments in infrastructure improvements (like lead service line replacement) are also driving demand for this industry.
- Water saving products. Environmental, Social, and Governance (ESG) goals and regulations are driving demand for water efficient and water reuse practices. Companies — both industrial and agricultural — are looking to reduce their need for water, motivating the creation of pumping and processing technologies that use water more efficiently.
- Resource recovery. Wastewater treatment plants are transitioning to resource recovery facilities that recover and use by-products from water, including energy, nutrients, and critical minerals. Many are assessing zero liquid discharge (ZLD) practices, an approach that recovers all water and reduces all contaminants to solid waste.
- Water-energy nexus. The growing awareness of the relationship between

energy and water is reshaping processes and even the valuation of water.

 Data in water systems. Artificial intelligence (AI) and robotics are disrupting water management, treatment and conservations processes.

# **DEFINING THE BLUE ECONOMY**

The collection of companies that develop and provide technologies, products and services that manage the movement, quality and use of water in addition to inputs to make these products, supporting industries and the customers that demand these products. In addition, **climate change** is already and will continue to significantly impact water-related economic opportunities and challenges - in ways we can anticipate and ways we do not yet understand. Globally, freshwater supplies are dwindling from increased demand and the impacts of climate change (for example, the western US appears to be experiencing a "megadrought," with low rainfall conditions not seen in over 400 vears).<sup>1</sup> In other areas, higher temperatures are resulting in increased rainfall due to higher water vapor volume, often increasing the frequency and intensity of flooding events.<sup>2</sup> Population and business growth are driving increased demand for water in rural areas and high-growth cities alike. Desalination processes are becoming more advanced in an effort to increase fresh water in regions with limited supplies. All of these conditions are driving up demand for water technologies that can be produced in Illinois.

In the Great Lakes region in particular, availability of fresh water may attract industrial and residential climate refugees to the area, but will simultaneously underscore the need for water conservation and water quality efforts as additional burdens are placed on our freshwater supply.

These developments and more are affecting a vast range of water industries and users,

presenting new opportunities for advanced products and services. For regions with the right resources and assets, these changes provide an avenue to driving inclusive economic growth.<sup>3</sup> Many of the treatment, monitoring and infrastructure solutions to address global challenges and opportunities are, or can be, produced in the Great Lakes region and exported around the world.

Leveraging a strong backbone of industry, research, and civic leadership, Illinois has a unique opportunity to invest in inclusive growth in the water industry and create opportunities for transformative economic growth. To build on these strengths, we must first understand the size, shape, and unique opportunities of our region's water industry and identify the strategies needed to create a globally significant Blue Economy by 2030. This report explores the landscape of our existing Blue Economy, analyzes market-driven opportunities to boost it, and makes strategic recommendations for action.

Perhaps most importantly, our region needs civic, academic and industry leaders to boldly champion these inclusive growth strategies. We hope these leaders use this report as a blueprint to guide investment and strategic priorities to make Illinois a global hub for water innovation by 2030.



## **Project Goals**

# VISION

By 2030, Illinois will be home to a thriving and inclusive Blue Economy where water companies, corporate water users, utilities and research institutions collaborate to develop, manufacture, and distribute nation-leading treatment and monitoring technology, catalyzing environmental solutions and inclusive economic growth.

Given the growing demand for water and the associated processes, products and technologies to manage it, the time is right to create a strategy to guide economic growth within the water sector.

The primary goal is to grow the "core water cluster" — that is, the technologies, products and services that manage the movement, quality and use of water.

Following from core water cluster growth, secondary goals of the project include:

- Grow/Attract Users Municipal, commercial and residential users of water, and the technologies, products and services of the core cluster to manage it.
- Market Water as an Asset This includes boosting the sale and value of water as well as increasing efficiency of use and stewardship. Water is chronically undervalued, and the high energy costs to treat manage and move it are frequently unaccounted for. In addition, valuable products can be recovered from "waste" water and reused in other markets.

Finally, tied to the economic growth objectives are water conservation objectives. As described above, water conservation and water quality management **create demand** for growth of the water sector.



To assess opportunities within the water cluster, this strategy first defines and draws bounds around the water cluster (to the extent possible, given that it has "fuzzy" edges). To identify which economic activites are clustering in the region, data analysis is used as a starting point - and is complemented with interviews and literature reviews to heavily inform the conclusions, all of which will be continually refined as the market continues to evolve and additional interviews focus the report's findings even further. This report assesses global markets and trends, analyzes the Illinois and Wisconsin region assets and identifies where the Chicago MSA can best compete, creates a vision for the Chicago MSA and defines a set of strategies to realize the vision.4



# Project Geography



Just like water, economic activity does not neatly align with political boundaries. The economic fates of neighborhoods, regions, and even multiple adjacent metropolitan areas are deeply linked, because these places are largely parts of the same economy. They share labor pools and housing markets; business-to-business relationships and supply chains; infrastructure and commuting patterns; cultural, recreational, retail, and other amenities; and anchor institutions, such as hospitals and universities.

Generally, metropolitan regions are considered a key unit of economic analysis — as described in more detail in the **Economic Approach** section. This Strategy encompasses the states of Illinois and Wisconsin — and analyzes metropolitan regions within these two states. The proposed strategies are targeted to the Chicago MSA. In some cases, the strategies aim to connect assets across metropolitan regions, given that they share a significant water resource (Lake Michigan) and supply chains.



Areas of Proposed Strategy for the Blue Economy

# III. What is the Blue Economy?

## DEFINING The Blue Economy

The collection of companies that develop and provide technologies, products and services that manage the movement, quality and use of water — in addition to inputs to make these products, supporting industries, and the customers that demand these products (see Figure 1).

### FIGURE 1 What is the Blue Economy and the Water Cluster?



Other definitions: Globally, the Blue Economy has several definitions – each of them broad, most of them focused on marine and ocean resources rather than the freshwater resources that are the focus in the Great Lakes.<sup>5</sup> For example, the World Bank defines the Blue Economy as the "sustainable use of ocean resources for economic growth, improved livelihoods, and jobs while preserving the health of ocean ecosystem." The Great Lakes Commission defines the Blue Economy as "the return on investments in environmental restoration and water-related infrastructure, and the ecosystem benefits and services generated by the Great Lakes." The World Economic Forum's "Freshwater Future" report shows how the blue economy can enable and accelerate the transition to a green economy."

The measurements of its impact are similarly vast, with one source stating that in 2018, the US Blue Economy, "supported 2.3 million jobs and contributed \$373 billion to our GDP" — and, globally the Blue Economy is expected to reach \$3 trillion by 2040."<sup>6</sup> In San Diego, TMA BlueTech's analysis of the Blue Economy found that every "dollar invested in our local Blue Economy goes farther and creates more return (\$2.26 dollars) than other industries per dollar invested."<sup>7</sup>

The opportunity: The Blue Economy encompasses tremendous economic opportunity, but they are disorganized and unevenly distributed. For our region to best develop a Blue Economy, we need a deliberate, focused economic growth strategy that leverages existing assets and investments and catalyzes new ones. With federal investments in infrastructure. increasing interest in corporate stewardship, and the ever-changing landscape of global water challenges, the moment is right to invest in creating a globallysignificant, nation-leading, inclusive Blue Economy in Illinois and the Great Lakes region by 2030. Defining viable inclusive economic growth opportunities where Illinois has the "right to win" is the first step. To do this, we must develop a deeper understanding of the market dynamics at play in the Blue Economy.

For our region to best develop an inclusive Blue Economy, we need a deliberate, focused economic growth strategy that leverages existing assets and investments and catalyzes new ones.







# IV. Economic Approach

This analysis is guided by a series of key principles drawn from extensive research, analysis and practice addressing anticipated changes and trends in the next economy. These changes have implications for economic development practice and inform a methodology for market analysis, and strategy development. This section summarizes these principles and the methodological approach. See **Appendix D** for more detail.

# Market Dynamics in the Blue Economy

Clustering is a natural market phenomenon that occurs when related firms group together in a specific geography due to the benefits they derive from that co-location. More precisely, a cluster is a group of firms and related economic actors and institutions that are located near each other<sup>8</sup> and "draw productive advantage from their mutual proximity and connections."<sup>9</sup> A cluster that is operating optimally can drive regional economic growth by enhancing firm productivity through:

- Reducing transportation and infrastructure costs due to close firm proximity;
- Enabling the development and sharing of specialized labor pools and other inputs common across firms;

- Providing firms more efficient access to customers, who may also be geographically concentrated (either as a cause or effect of firm clustering); and
- Facilitating innovation through "knowledge spillovers" — the informal learning and knowledge exchange that results from inperson interactions.

To constitute a cluster, the concentrated firms, suppliers, institutions, labor pools, infrastructure, R&D, and so on,<sup>10</sup> must be interdependent actors linked economically, socially and technologically within a region.<sup>11</sup>

Developing a strategy aligned with regional water cluster opportunities requires carefully assessing each of these components to identify what firms and economic activities are in fact clustering locally and why, and identifying which sub-parts of the water cluster our region is most competitive in, current and emerging market opportunities, determine what supporting factors are most in need of development (e.g., suppliers, workforce skills, R&D and commercialization), etc. This complete definition and analysis of the cluster will show the regionally specific opportunities and point toward the strategies and initiatives that are tailored to those unique conditions.

## The Water Cluster

Our water cluster definition is based on an assessment of the products, technologies and services that are supplied to high-volume water users.



The companies that develop and provide technologies, products and services that manage the movement, quality and use of water.

#### FIGURE 2

### The Water Cluster and its Relationships to Inputs, Related Industries, and Demand Conditions

#### **Government Regulations**

Examples include:

- 1. Great Lakes Compact
- Illinois SB 2408 ("CEJA") establishes a "Climate Bank" to "develop opportunities to ... provide clean water, drinking water, and wastewater treatment in the State."
- 3. Illinois Nutrient Loss Reduction Strategy

#### **Factor Conditions**

What existing inputs (labor, infrastructure, knowledge) in the region feed into the water cluster?

EXAMPLES Freshwater supply

Workforce (~110,000 water-related jobs)

R&D strengths (national laboratories, university research centers, etc.)

Institutional support

# Firm Structure, Strategy and Rivalry

How is competition between firms in the region pushing them to distinguish themselves in the marketplace?



EXAMPLES Metals manufacturing Electrical equipment manufacturing Chemistry & biopharma Engineering Data processing

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#### **Risk Factors**

Extreme weather events can cause harm (e.g., rising lake levels, increased run-off and water pathogens, damage to crops and infrastructure)—and increase the pace of water technology innovation.

#### **Demand Conditions**

Who are the main users of the product/services provided by the core firms in the water cluster?

EXAMPLES Manufacturing sector Agriculture sector Food & beverage industr Semiconductor industry

Diagrammed using the Porter Diamond method (see Appendix E for more detail on cluster theory)

#### **FIGURE 3**

#### The Water Cluster: Examples of the Products and Services Within the Cluster

	CLEANING (water quality)	USE (water efficiency)	MOVEMENT (water infrastructure)			
Products	<ul> <li>Microfiltration</li> <li>Ultrafiltration</li> <li>Ion exchange/electro-deionization</li> <li>Degasification</li> <li>UV products</li> <li>Reverse osmosis water filters</li> <li>Activated carbon water filters</li> <li>Filters/screens</li> <li>Membrane technology</li> <li>Desalination technology</li> <li>Aeration technology</li> <li>Chemicals</li> <li>Centrifuges</li> <li>Measurement instruments</li> <li>Data platforms</li> <li>Sensors</li> </ul>	<ul> <li>Low-flow plumbing fixtures</li> <li>Appliances</li> <li>Space cooling systems</li> <li>Space heating systems</li> <li>Rain barrels</li> <li>Landscape and irrigation systems</li> <li>Other (e.g., swimming pools)</li> <li>Building automation systems</li> <li>Building management systems</li> </ul>	<ul> <li>Pipes</li> <li>Pumps</li> <li>Meters</li> <li>Controls</li> <li>Valves</li> <li>Nozzles</li> <li>Motors</li> <li>Fasteners</li> <li>Mixing technologies</li> </ul>			
Associated Services	Water treatment and purification	Water management consulting	Building services			
	<ul> <li>Physical water treatment</li> <li>Biological treatment</li> <li>Chemical water treatment</li> <li>Sludge treatment</li> <li>Boiler/cooling water treatment</li> <li>Reverse osmosis solution</li> </ul>	<ul> <li>Water reuse and recycling</li> <li>Energy saving solutions</li> <li>Water saving solutions</li> <li>Pumping/delivery</li> </ul>	<ul> <li>Maintenance and operations</li> <li>Boiler system specifications</li> <li>Cooling tower specifications</li> <li>Architecture, engineering, construction</li> <li>Installation</li> </ul>			
	Inspection and testing	Tech	Conservation			
	<ul> <li>Water safety testing</li> <li>Inspection, cleaning, disinfection</li> </ul>	<ul> <li>Automation, monitoring, control</li> <li>Real-time data analysis, reporting</li> <li>Artificial Intelligence development</li> </ul>	Green Infrastructure     Ecosystem Services			

Artificial Intelligence development

The products and services within the water cluster may include, but are not limited to, those in Figure 3. This list is provided as an example of the range and variety of products that are used to assist in the use, cleaning and movement of water.

Products, technologies, and services in the water cluster supply a diverse audience of water users throughout the region and are also exported globally. Every industry, and residence, uses water, which

creates demand conditions for treatment, monitoring and infrastructure products. Water users range from high-volume water users like food and beverage manufacturers and energy production facilities to public water management facilities like wastewater treatment plants. The needs of each user vary according to the level of water purity required, level of contamination post-use, and existing processes. This work aims to accelerate the market for water products, technologies and services and connect

the region's water cluster with users who stand to benefit from more efficient processes and better water quality. Successful strategy design and implementation will require regional partner participation and collaboration.

## A New Approach to Economic Growth

The economy is changing — becoming more global and dynamic, rewarding continuous innovation, heightening the importance of rich, flexible crosssector networks efficiently deploying and connecting human capital, business, technology and other assets. Sustained regional economic development must be anchored by production-driven economies that compete by adding value building on their unique assets, strengths and opportunities.<sup>12</sup> New practices emphasize:

- Competing on value added, instead of low-cost
- Identifying unique strengths and "building from the inside out"
- Acting strategically through contextspecific, integrated solutions
- Focusing on inclusive growth (see **Inclusive Growth** section)

Successful regions are developing and implementing comprehensive, integrated and inclusive strategies across the five market levers (discussed below) that determine productivity. Responding successfully to these economic principles requires that the Chicago MSA deliberately builds upon its unique assets — all of them — to clearly define its competitive advantage in the water sector.





A core dimension of market-based growth is inclusion. Inclusive growth does not refer to a separate inclusion practice, nor to traditional equity work, as important as those remain. Rather than let growth occur and then ask how the people and places left out can get some set-aside, redistribution or limited participation, inclusive growth is a different approach to all growth, seeking to fundamentally reposition disadvantaged people and places, particularly communities of color, as drivers and beneficiaries of the enormous growth opportunities in the new economy.<sup>13</sup>

The economic analysis views inclusion as central to growth — and sets goals with respect to inclusive growth, focusing on four dimensions for underserved individuals/ communities (*BIPOC; women; Environmental Justice (EJ) communities*):

- Ownership/Entrepreneurship growing company and real estate ownership by — and increasing entrepreneurship in underserved individuals/communities;
- Employment increasing employment of underserved individuals, particularly in quality jobs with strong career ladders;
- Location and Access siting and supporting firms in places that are readily accessible to underserved populations and assuring transportation and other infrastructure access to centers of jobs and other economic activity;
- **Participation** ensuring underserved representation at the relevant private, public and civic sector "tables," where growth strategies are shaped and deals get done.

Quality, inclusive growth practices that increase the employment, ownership, access and participation of BIPOC communities in the region's emerging water sector opportunities are essential to achieving lasting economic prosperity.

Quality, inclusive growth practices that increase the employment, ownership, access and participation of BIPOC communities in the region's emerging water sector opportunities are essential to achieving lasting economic growth. Each of the growth strategies that have evolved from this plan have been shaped by the opportunities in those four avenues to inclusion.

## **Key Drivers of Growth**

In the new economy, five market levers (listed below and diagrammed in Figure 4) account for the efficiency and productivity of regional economies and drive how much complementary, concentrated assets realize synergies.<sup>14</sup> Together, they provide a framework

#### FIGURE 4 Five Market Levers for Economic Growth



for understanding a region's economic assets, challenges and opportunities.

This market analysis leads to a set of strategies that will grow the economy — specifically, the technologies, products and services that manage the movement, quality and use of water. Growth occurs:

- Primarily through growth of **existing businesses**
- Secondarily through entrepreneurship
- Finally through **business attraction** (particularly, flowing from existing business growth and entrepreneurship)

Successful economic growth, focused on growing existing businesses, depends on how well each of the five market levers relate. This project will focus on analysis of the water cluster, as well as the key intersections of the workforce and technology (innovation) that — when connected by the right built and virtual environment (spatial efficiency) and institutional environment (governance) will create the synergies that make the Chicago MSA the most productive and thus competitive for water-related industries, firms and associated workforce.



# V. Market Analysis

A deep market analysis assessed which products and services are clustering within the Illinois and Wisconsin region. This report focuses on opportunities within the Chicago MSA to develop and grow the water cluster, and opportunities to strengthen connections to assets across the state and in the Milwaukee region.

Taking a closer look at the products in Figure 3, their distinct supply chains (diagrammed in Figure 5) — as well as factor conditions, related industries, and demand conditions — point to three major opportunities:

- 1. Treatment
- 2. Monitoring/Sensing
- 3. Infrastructure and Fixtures

Although there are overlaps within this complex sector, for the sake of clarity the market analysis highlights findings within these three categories. The market analysis also explores horizon opportunities in these emerging areas:

#### 1. Data Integration in Water Systems

#### 2. Water-Energy Nexus

#### 3. Resource Recovery

The report also highlights the need for systems-wide collaboration. For instance, data platforms and other smart technology are often integrated into aging infrastructure — creating a need for systems-wide troubleshooting (e.g., deploying smart meters in Chicago resulted in increased lead exposure from disrupting pipe infrastructure).<sup>15</sup> An added challenge is that each building and application is different, creating a need for customized rather than standardized water products. Despite these challenges, there is significant investor interest in water sector growth. After largely flat growth in overall M&A transactions in the water sector from 2012 to 2017 (2 percent per year), growth has jumped to 16 percent annually — with activity from private-equity and infrastructure funds increasing to 26 percent annually.<sup>16</sup> These challenges and opportunities are explored in the next section.

#### **FIGURE 5**

#### Relationship/Supply Chains Across Water Movement, Use and Quality



Note: Location Quotients (LQs) listed are for Chicago MSA. Numbers in red represent low LQs, threshold of 0.8. LQs listed are for Chicago MSA.

## **Global Markets**

#### Treatment

There is a pressing need to manage the many emerging contaminants that enter our water supply, generated by things like pharmaceuticals, fertilizers, pesticides, and consumer products. 90% of oral drugs end up in the water supply after passing through our bodies.<sup>17</sup> Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) — manufactured chemicals used to make products across several industries (e.g., aerospace, automotive, construction, electronics, and military) — are difficult to break down, end up in our water supply, and cause significant health concerns.<sup>18</sup> In addition to

known contaminants, the list of emerging contaminants is ever-growing, demanding an increased pace of technology development to treat these chemicals (and increased pace of regulatory development as well).

The global water and wastewater treatment market is expected to reach a value of \$956.48 billion by 2032, with a compound annual growth rate (CAGR) of 5.4% between 2022-2032.<sup>19</sup> Segmented by offering, the market includes: treatment technologies, treatment chemicals, process control and automation, design, engineering, and construction services, and operation and maintenance services (see Figure 6). Major companies in this market include Xylem, Inc. and Suez SA.



### FIGURE 6 Growth Among Water and Wastewater Treatment Segments

The size of bubbles represent the market size in 2032.

Source: Global Water and Wastewater Treatment Market, Meticulous Research

Within this market, wastewater treatment accounts for 62.3% while water treatment accounts for 37.7%.<sup>20</sup>

- Wastewater treatment removes both suspended and dissolved organic and inorganic substances, as well as natural and synthetic organic chemicals. Industrial wastewater in particular is a higher risk than domestic wastewater as its toxins can cause poisoning, immune system suppression, or reproductive failure. Industrial wastewater treatment is moving towards recycling and reuse of treated water, energy generation during purification (see Water-Energy Nexus subsection below), and nutrient recovery (see Nutrient Recovery sub-section below).
- Water treatment removes suspended impurities, solids, colloids, and living organisms from raw water and delivers potable water to users. In addition to providing drinking water, water treatment is especially important to industrial manufacturing processes to meet standards for process water requirements in pharmaceutical, food and beverage and semiconductor manufacturing.

Operation and maintenance represents the largest segment, largely due to the increasing complexities of water and wastewater treatment facilities as innovative water technologies are integrated into processes.<sup>21</sup> The segments that are expected to grow at the highest CAGR are **process control and automation**, and **treatment technologies**.

Treatment technologies includes subsegments like membrane separation and filtration, sludge management technology, activated sludge, clarification, chlorination, industrial demineralization, membrane bioreactor (MBR), UV and ozone, and dissolved air flotation. Of these, **membrane separation and filtration** is projected to



dominate the market (\$28 Billion, 8.4% CAGR) and is further segmented into:<sup>22</sup>

- Reverse Osmosis (RO) membranes
- Ultrafiltration (UF) membranes
- Microfiltration (MF) membranes
- Nanofiltration (NF) membranes

Advanced filtration techniques are becoming more prominent because they can filter out more complex contaminants — and also replace chemicals as a means of water treatment. Innovations in membrane filtration are growing to remove contaminants ranging from PFAS, to organic matter such as algae, to micropollutants — with greater accuracy and efficiency.<sup>23</sup> The increasing prevalence of new contaminants demands innovation in treatment. This could involve integration of membrane filtration with biological processes, or Forward Osmosis systems which help comply with regulations like zero liquid discharge or recovery of 95-99% of water from waste streams for reuse.<sup>24</sup>

Applications of treatment technologies are largely for municipal treatment (69.1% of the market) but also industrial treatment (30.9%) — with the industrial treatment market projected to grow at a higher CAGR (6%). Municipal treatment often goes through several rounds of treatment, with preliminary focused on screening for sediments and later-stage treatment using biological treatment processes. The technologies used in industrial treatment largely depend on the specific contaminants and enduse, but for instance: food and beverage manufacturers use chemical and biological processes to treat the high amount of sugar, flavorings and additives in discharge. Many pharmaceutical manufacturers must use advanced wastewater treatment technologies (e.g., electrochemical advanced oxidation processes) to address the growing presence of Active Pharmaceutical Ingredients (APIs) that enter water streams.25

To adopt new technologies, within both industry and municipal settings, typically significant proof of concept is needed to be sure there are no negative impacts – to food quality, or to drinking water quality.

#### **Monitoring/Sensors**

Treatment cannot occur without monitoring and testing; these sectors are closely linked. **The projected global market for Water Quality Monitoring Devices is \$4.1 billion by 2026, at a CAGR of 5% (2021-2026).**<sup>26</sup> Some of the most notable segments within this are:

- TOC Analyzers (\$1.3 billion, 6.3% CAGR)
- pH Meters (\$810.2 million, 5% CAGR)

Used across municipal, commercial and residential applications, water sensors can detect pressure, flow, acoustics, temperature and chemical measurements.<sup>27</sup> They can also detect the presence of unexpected pollutants within water.<sup>28</sup> Examples of sensors and their use:<sup>29</sup>

- **pH Sensor** determines how much acidity and alkalinity is present in water and other liquids; critical to ensure safety of water (for instance, in water treatment plants or manufacturing operations)
- Turbidity Sensor determines number of suspended particles in water by projecting a light beam into the sample and measuring light that is reflected back
- Conductivity Sensor evaluates the ion concentration in the solution (conductivity increases with more ions present)
- ORP Sensor provides more information than pH sensors; for instance, can be used to assess chemical treatment in waster has the desired effect
- TOC Analyzers test the dissolved oxygen present in water bodies to determine pollution levels

Increased demand for both treatment and monitoring is driven by stringent water treatment regulations (that differ by state), rapid population growth and urbanization, the growing emphasis on water quality and public health, and the increasing prevalence of waterborne diseases. There is a growing need across industry for high quality water — particularly to demonstrate compliance

# \$4.1 BILLION

The projected global market for Water Quality Monitoring Devices by 2026, at a CAGR of 5%



in pharmaceutical, environmental, and food sectors (see **Global Markets: Treatment** section). Government regulations require industries to test and treat wastewater before it is discharged into water bodies, pushing private industry to invest in instruments like TOC analyzers, as well as measurement devices to assess basicity, turbidity and alkalinity.<sup>30</sup>

Examples of major companies present in this market are Thermo Fisher Scientific, Inc., Evoqua Water Technologies LLC, Siemens, Danaher Corporation, Agilent Technologies, and General Electric Company.

### Infrastructure and Fixtures

Water infrastructure includes a diverse range of products, for instance: pipes (both plastic and metallic), fittings (e.g., elbow, reducer, tee type, cross type, coupling, unions, adaptors, valve, cap)<sup>31</sup> — as well as pumps and mixing equipment. Trillions of dollars need to be spent to repair, upgrade, and build water infrastructure worldwide over the

#### coming decades.<sup>32</sup> The water infrastructure repair technologies market is expected to reach \$131.6 billion by 2027, with a CAGR

of 6.5%.<sup>33</sup> Water-pipe replacement rates are projected to peak in 2035 (at 16,000 to 20,000 miles of pipes replaced per year four times the current annual replacement rate of 4,000 to 5,000 miles).

Additional market reports highlight some of the notable segments within water infrastructure:

- The pumps market is expected to reach \$13.5 billion by 2026, with a CAGR of 3.4%.<sup>34</sup>
- The pipes and fittings market is expected to reach \$8 billion by 2025, with a CAGR of 4.7%.<sup>35</sup>
- The stainless steel plumbing pipes market is expected to reach \$4.9 billion by 2030, with a CAGR of 4.8%.<sup>36</sup>

Water professionals in the US and Canada rank their most pressing water industry challenge as "renewal and replacement of



The projected water infrastructure repair technologies market by 2027, at a CAGR of 6.5% aging water and wastewater infrastructure."<sup>37</sup> The market for pipes and associated infrastructure is projected to grow significantly due to:

- Aging Infrastructure Most water systems are piecemeal and aging. The United States water-pipe network pipe is 45 years old, with some cast-iron pipes more than a century old,<sup>38</sup> and water utilities only replace about 0.5% of pipes every year.<sup>39</sup>
- Lead The EPA estimates that it could take an investment of up to \$839 million per year to replace and monitor the 9.7 million to 12.8 million lead service lines that are currently in use in the United States as a response to the updated Lead and Copper Rule.
- Leaks 14-18% of treated potable water is lost through leaks in the US (with some water systems over 60%).

With the significant demand for new pipes — and associated products like meters and valves — there is also an opportunity to time their replacement with integration of new systems (smart meters, measuring devices, data platforms). This presents a unique challenge where a legacy industry is converging with new innovative technologies.

Water saving plumbing products like lowflow fixtures have similar inputs (plastics manufacturers, metals manufacturers) as pipes and fittings — and therefore this section includes them as well. **The water saving plumbing market is expected to reach a value of \$5.4 billion by 2030, with a CAGR of 6.8% between 2021-2030.**<sup>40</sup>

Global water demand is expected to increase by 1.8% annually (and grow significantly over the next 2 decades), primarily in industry, domestic and agriculture.<sup>41</sup> Of the world's freshwater supply, 70% is consumed by agricultural irrigation, 20% by industry, and 10% by individuals.<sup>42</sup> In response, globally, water-use efficiency has risen by 9% (15% in industrial sector, 8% in services, 8% in agriculture)<sup>43</sup> — so, demand for water saving products is growing.

Further demand for water efficient products, particularly in municipal and commercial settings, is driven by regulations, building codes and plumbing fixture standards as well as increasing water prices. Small/ medium buildings are often a market left behind for water efficiency technologies because of the high upfront costs. In this market, most water conservation strategies are more ad-hoc and related to daily maintenance activities.



The projected water saving plumbing market by 2030, with a CAGR of 6.8%





## **Global Trends**

As the global markets grow for water treatment, monitoring and infrastructure products and services, additional trends are influencing and, in some cases, disrupting these markets, such as:

- 1. Data Integration in Water Systems
- 2. Water-Energy Nexus
- 3. Resource Recovery

### Data Integration in Water Systems

The water industry is undergoing a digital transformation of processes and infrastructure, enabled by technology like sensors that can collect real-time data and analytics platforms that can integrate and process high volumes of data.44 While the integration of these platforms with legacy systems and processes poses a challenge, there is significant opportunity to use AIbased data analytics platforms not just for greater management efficiencies but also to decarbonize water and wastewater treatment infrastructure.45 Keys to successful water data platforms often include legislative support, clear development plans with milestones and long-term funding to support and maintain tools over time.46

Artificial intelligence (AI), along with robotics, cognitive computing and big data, is likely to play a major role in water management, water treatment and water conservation<sup>47</sup> in addition to fueling innovation. Increased demand for software-as-a-service (SaaS) and network-as-a-service (NaaS) in multifamily, commercial, and utilities includes realtime data access, predictive technologies, data collection from sensors (one-way) and/ or control of physical equipment through user input or automation with optimization algorithms (two-way). "Ten years ago, utilities were mainly looking for engineering solutions like new membranes, sensors, and the like, but in the last three years or so everything has a digital element to it."48

The growing integration of data into water infrastructure and processes also creates a growing need for cybersecurity. EPA has discussed adding a cybersecurity component to National Pollutant Discharge Elimination System (NPDES) permits.<sup>49</sup>

### Water-Energy Nexus

The interdependency of water and energy systems has become a growing research topic with many applications (see Figure 7).<sup>50</sup> The cost of water use is inextricably tied to energy. Energy is used to extract, pump, deliver, and treat water - creating an additional driver of innovation in the water sector (to lower energy usage and its associated cost). For instance, utilities can now claim energy savings associated with building projects that reduce water use (e.g., low-flow toilets). In addition, energy production uses significant amounts of water, shifting demand to lower water-intense energy production, such as wind and solar PV (rather than more water-intense sources like biofuels).<sup>51</sup> By 2040, the amount of energy used in the water sector is projected to more than double.52

The future of water as a significant asset class depends on the willingness of governments — and ultimately of society at large — to price water at its long-run social marginal cost as a scarce renewable resource (including the cost of energy, and addressing the negative environmental externalities associated with its production and distribution).

Opportunities to reduce energy consumption within treatment systems or industrial applications include:<sup>53</sup>

- Pumping systems proper maintenance of the motors, pumps, and the overall system, as well as pump optimization software
- Energy-efficient ballasts for fluorescent fixtures and ultraviolet disinfection or pretreatment systems

Water's intersections with energy use will have impacts on growth of the water cluster.

#### FIGURE 7

#### Interdependency of Water and Energy Systems

#### How we use water for energy



#### **Electricity generation**

Nearly half of all water withdrawn in the U.S. keeps power plants cool enough to function safely and efficiently



#### Oil and gas

Water is used for hydraulic fracturing, enhanced oil recovery and other fossil fuel production processes

#### Renewables

Essential for hydropower, water is also used for concentrated solar power, for geothermal energy and to produce bioenergy

#### How we use energy for water



#### Pumping

We use energy to pump water from aquifers for agriculture and to transport to treatment facilities and consumers

#### Heating and cooling



Energy and water work together to keep buildings and equipment at safe, comfortable temperatures

# R



#### Water treatment

Energy is needed to desalinate water and treat wastewater before it's returned to the environment



#### Delivery

We use energy to distribute and heat water for cooking, showering, cleaning and drinking

Source: https://www.energy.gov/articles/ensuring-resiliency-our-futurewater-and-energy-systems

Global energy trends will impact water usage and associated demand for waterrelated products. While growing renewable production can be seen as a demand condition that influences growth of the water cluster, there is also significant overlap in the products associated with the water cluster and energy sector.

### **Resource Recovery**

Pioneering methods in nutrient recovery, biogas generation and biosolids as a beneficial resource will shift perspectives of wastewater treatment plants to become "water resource recovery facilities" that can produce clean water and recover by-products. These facilities recover resources such as nutrients (phosphorus and nitrogen), highvalue carbon products, rare earth elements (metals), and high-quality biosolids.<sup>54</sup> It is estimated that half of the wastewater utilities in the United States are on a pathway to become resource recovery facilities.<sup>55</sup>

Although these processes are not yet widespread,<sup>56</sup> treatment plants are beginning to recover and use by-products such as (see Figure 8):<sup>57</sup>

- Nutrients like nitrogen or phosphorus for fertilizer
- Sewage sludge for energy
- Biosolids (treated sewage sludge) for compost

- Bioplastics for manufacturing processes
- Critical minerals, like Nickel, Cobalt, Lithium, and other rare earth elements essential for battery production

In 2016, the Metropolitan Water Reclamation District of Greater Chicago (MWRD), opened the world's largest nutrient recovery facility at the Stickney Water Reclamation Plant. It has the potential to recover 2.3 million pounds per year of usable phosphorus, which can be sold in stores and used in fertilizers.<sup>58</sup> As another example, MWRD is also recovering biosolids (the solid residuals from the wastewater treatment process) and mixing it with wood chips to produce highquality compost.<sup>59</sup>

These recovery efforts have the potential to become significant revenue streams for the region, in addition to the environmental benefits of recovering waste. The products and processes needed to recover byproducts and grow new markets will drive further demand for water-related products — and will contribute to water cluster growth and growth of new markets.



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#### FIGURE 8 Waste Resource Recovery Facility By-Products

Source: https://www.worldbank.org/en/topic/water/publication/wastewater-initiative

## Illinois and Wisconsin: Assets and Market Position

### Water Cluster Size

To estimate the size of the water cluster in the region, the products and services listed in Figure 3 were mapped to their most relevant industry code (see **Appendix D**). It should be noted: the list of industry codes includes things like "Data Processing, Hosting, and Related Services," which serve industries



well beyond the water cluster. While the data includes more than just water-related firms, it is over-inclusive in order to broadly assess the strengths across the region, many of which can be pivoted to serve water industries.

#### TABLE 1

#### Water Cluster Summary, by Geography

Geography	Output	Establishments (2020)	Employment (2020)	Female	BIPOC	<hs (age 25+)</hs 	HS (age 25+)	Assoc. (age 25+)	Bach+ (age 25+)
US	\$483.6 billion	505,127	5,347,925	30%	29%	12%	25%	30%	32%
Illinois	\$16.7 billion	19,169	186,476	31%	30%	13%	26%	30%	30%
Chicago MSA	\$12.6 billion	11,756	133,958	30%	30%	12%	22%	29%	37%
Wisconsin	\$6.6 billion	7,000	90,000	32%	14%	10%	30%	33%	27%
Milwaukee MSA	\$2.2 billion	1,645	27,508	29%	16%	9%	27%	32%	31%

#### TABLE 2

#### The Blue Economy Comparative Summary, by Geography

	Water Cluster		The Blue Econd	omy	Total Economy		
Geography	Establishments (2020)	Employment (2020)	Establishments (2020)	Employment (2020)	Establishments (2020)	Employment (2020)	
US	505,127	5,347,925	1,960,884	36,820,791	10,185,381	117,940,040	
Illinois	19,169	186,476	74,614	1,454,614	368,119	4,822,617	
Chicago MSA	11,756	133,958	49,031	1,012,892	235,146	3,490,816	
Wisconsin	6,982	90,231	33,305	763,761	170,628	2,365,659	
Milwaukee MSA	1,645	27,508	8,165	216,206	46,359	703,171	

### Water Cluster Strengths

Looking at top 10 employment concentrations in water-related industries with high LQs:

- Chicago MSA: strengths in R&D, professional services, metals manufacturing (see Table 3)
- Milwaukee MSA: manufacturing strengths specific to water technologies (chemicals, measurement devices) (see Table 4)

Given that the regions share supply chains and economies, there is potential to commercialize more of Chicago's R&D (e.g., water sensors) through greater collaboration across geographic boundaries, linking supply chains with specialty manufacturing in chemicals, electrical, metals, and even material innovations in 3D printing.

While inclusion metrics in employment (female, BIPOC, those without a degree) are slightly better than national averages within these industries, this work aims to further

#### TABLE 3

## Chicago MSA, 10 Largest Industries by Employment

			ESTABLISHMENTS			EMPLOYMENT			INCLUSION		
NAICS	NAICS Description	2019 AP (\$K, nominal)	2019 Estabs	2019 Est LQ	2010-2019 Estab Growth	2019 Emp	2019 Emp LQ	2010-2019 Emp Growth	Percent Female	Percent BIPOC	Percent <bachelors (age 25+)</bachelors 
238220	Plumbing, Heating, and Air- Conditioning Contractors	2050782	2801	1.08	3%	26288	0.77	34%	15%	19%	35%
541330	Engineering Services	2013535	1309	0.71	-12%	20374	0.67	18%	31%	27%	26%
541715	Research and Development in the Physical, Engineering, and Life Sciences (except Nanotechnology and Biotechnology)	1320715	211	0.54	36%	11373	0.88	-22%	37%	31%	24%
518210	Data Processing, Hosting, and Related Services	1196773	424	0.68	-4%	8925	0.86	31%	37%	31%	25%
541310	Architectural Services	759872	929	1.59	-19%	8300	1.42	23%	31%	27%	26%
541990	All Other Professional, Scientific, and Technical Services	541625	1592	1.60	108%	6131	1.17	206%	63%	26%	28%
811310	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	357310	629	0.91	-7%	5125	0.79	15%	19%	26%	32%
541380	Testing Laboratories	444246	208	0.87	-7%	5003	0.95	9%	31%	27%	26%
541690	Other Scientific and Technical Consulting Services	367709	732	0.65	-15%	4019	0.68	38%	47%	34%	26%
332722	Bolt, Nut, Screw, Rivet, and Washer Manufacturing	261572	96	5.22	7%	3888	3.23	28%	23%	37%	30%

#### TABLE 4

#### Milwaukee MSA, 10 Largest Industries by Employment

			ESTABLISHMENTS			EMPLOYMENT			INCLUSION		
NAICS	NAICS Description	2019 AP (\$K, nominal)	2019 Estabs	2019 Est LQ	2010-2019 Estab Growth	2019 Emp	2019 Emp LQ	2010-2019 Emp Growth	Percent Female	Percent BIPOC	Percent <bachelors (age 25+)</bachelors 
238220	Plumbing, Heating, and Air- Conditioning Contractors	416372	423	0.83	4%	5573	0.82	36%	13%	9%	38%
541330	Engineering Services	456310	462	1.27	60%	5297	0.88	31%	27%	12%	30%
518210	Data Processing, Hosting, and Related Services	588596	62	0.50	11%	4427	2.16	-5%	48%	20%	29%
811310	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	88937	133	0.98	-10%	1232	0.96	24%	18%	11%	38%
541310	Architectural Services	105122	96	0.84	2%	1193	1.03	29%	27%	12%	30%
333318	Other Commercial and Service Industry Machinery Manufacturing	70239	22	2.26	-8%	985	2.53	12%	26%	17%	32%
325199	All Other Basic Organic Chemical Manufacturing	60540	11	2.62	22%	813	3.43	28%	29%	32%	33%
334513	Instruments and Related Products Manufacturing for Measuring, Displaying, and Controlling Industrial Process Variables	44373	18	1.95	13%	680	1.79	-5%	31%	23%	31%
237110	Water and Sewer Line and Related Structures Construction	50892	37	0.64	-23%	606	0.54	-3%	13%	10%	32%
541380	Testing Laboratories	35791	47	1.00	0%	519	0.50	14%	27%	12%	30%

diversify employment and ownership — as their national averages are also low. Estimated BIPOC ownership within water-related industries is incredibly low, at around 5%.<sup>60</sup>

Looking instead at industry concentrations and growth at both the County and MSA level, data assessment of all NAICS within the water cluster definition reveal that:

• Chicago MSA has the right concentration of growing manufacturing, engineering, and data industries to support growth of the water cluster, particularly in:

- Automatic environmental control manufacturing
- Industrial valve manufacturing
- Pipe fitting manufacturing
- Engineering services
- Data processing and hosting
- Milwaukee MSA has a strong water cluster (most of the industries within it are experiencing growth)

#### FIGURE 9 Cook County: 2019 LQ vs 2010-2019 Growth in LQ

#### Blue Economy Private Sector Job Trends, Cook County, IL STRONG BUT SLIPPING STRONG AND COMPETITIVE (n = 7)**t t** Automatic environmental control mfg. for residential, commercial + appliance use (146%, 2.2) Plumbing fixture fitting + trim mfg. (-33%, 2.9) Measuring, dispensing, 2.0 Architectural svcs. other pumping equipment mfg. (-35%, 2.7) Other commercial 2019 + service industry machinery mfg. Other management Concentration Relative to U.S., 1.5 All other professional, consulting svcs scientific, + technical svcs. (99%, 1.2) Data processing, hosting, + related svcs Landscape architectural svcs. All other misc. mfg. (-50%, 1.1) Environment, All other misc Totalizing fluid meter conservation. chemical product Bolt, nut, screw, rivet + washer mfg. + wildlife + counting device mfg. (110%, 1.1) + preparation mfg. organizations 1.0 R+D in the physical, Other scientific + technical consulting Comm. + industrial Testing labs Engineering svcs. engineering, + life sciences (-57%, 0.5) machinery + eqpt. repair Analytical lab instrument mfg. svcs. All other misc. waste management svcs. maintenance Other basic inorganic chemical mfg. (63%, 0.7) All other basic 0 Fluid power valve + hose fitting mfg. organic chemical mfg Other metal 0.5 Other measuring + controlling device mfg. (-60%, 0.4) valve + pipe fitting mfg. Water + sewer line + related structures construction Industrial Plumbing, heating + A/C contractors valve mfg. Facilities support svcs. (470%, 0.3) Fluid power pump + motor mfg (-55%, 0.3) Remediation svcs. Plastic material + resin mfg. Environmental Instruments + related products Water supply Fabricated pipe + pipe fitting mfg. (-57%, 0.1) Carbon + graphite product mfg. consulting Plastic pipe + pipe fitting mfg. mfg. for measuring, displaying, + controlling industrial process variables SVCS irrigation systems (116%, 0.3) 0.0 -50% -40% -30% -20% -10% 0 10% 20% 30% 40% Growth in Concentration Relative to U.S., 2010-2019 **EMERGING** DETERIORATING (n = 14)

Notes: The size of bubbles represent employment concentration; Black arrows indicate those that are "off the chart;" All other pipeline transportation and sewage treatment facilities are not shown because the industries had less than 10 jobs in 2019; Reflects private sector jobs only; Cook, Rest of MSA, and Rest of IL bubbles are at the same scale on size basis

Source: dF-QCEW

See Figures 9-10 for County data (and see Appendix A for MSA data, excluding the County). While the Milwaukee region has many less firms and thus lower employment, its water-related industries are typically strong, competitive or emerging.

Looking more closely at the Chicago MSA, it has several industry strengths that relate to treatment, monitoring, and water infrastructure and fixtures - indicating that, with the right strategic support, the region is poised to compete globally across each of these categories.



(n = 7)

50%

(n = 11)
#### Treatment

- Automatic Environmental Control Mfg. (LQ 7.6)
- All Other Misc. Chemical Product and Prep. Mfg. (LQ 2.14)

#### Monitoring

- Automatic Environmental Control Mfg. (LQ 7.6)
- Automatic Env. Control Mfg. for Res., Com., and Appliance Use (LQ 4.76)

 Measuring, Dispensing, and Other Pumping Equipment Mfg. (LQ 1.17)

#### Water Infrastructure and Fixtures

- Other Metal Valve and Pipe Fitting Mfg. (LQ 2.81)
- Plumbing Fixture Fitting and Trim Mfg. (LQ 1.94)
- Industrial Valve Mfg. (LQ 2.5)
- Fabricated Pipe and Pipe Fitting Mfg. (LQ 1.5)

#### FIGURE 10

### Milwaukee County: 2019 LQ vs 2010-2019 Growth in LQ



(n = 16)

Notes: The size of bubbles represent employment concentration; Black arrows indicate those that are "off the chart;" All other pipeline transportation, analytical laboratory instrument mfg., automatic environmental control mfg. for residential, commerical, and appliance use, fluid power pump and motor mfg., industrial valve mfg., other management consulting svcs., other metal valve and pipe fitting mfg., plastics material and resin mfg., and water supply and irrigation systems are not shown because the industries had 10 or fewer jobs in 2019; Reflects private sector jobs only; MKE County and Rest of MSA bubbles are at the same scale on size basis.

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Source: dF-QCEW





#### **Universities and Research Labs**

The region has several regional research and development institutions, which have water-related research focuses and help accelerate innovation. Highlights include:

- Northwestern University Center for Water Research — A hub for research and partnerships including the US-Israel Collaborative Water-Energy Research Center, which has developed a pipeline for scaling up and pilot testing water technologies and materials for desalination, safe water reuse, and resource recovery; the SAGE National Sensing and Edge Computing Infrastructure; the Illinois and Chicago Wastewater Surveillance networks; and NSF and DOE-funded efforts on resource recovery from wastewater.
- UChicago's Pritzker School of Molecular Engineering (PME)'s joint

## Water Initiative with Argonne National

**Laboratory** — Specializes in molecular engineering approaches to water production, purification, and preservation.

- Research Center on Advanced Materials for Energy-Water Systems

   Led by Argonne, this DOE-funded, includes multiple PME/UChicago faculty
- Argonne National Laboratory (Argonne) initiatives — Broadly,

members.

Argonne has expertise in water science and engineering, additional research in materials, selective separation, sensors and controls, modeling and Al/ML, manufacturing, and sustainability. It moves materials, sensors and process technologies from discovery to application by tapping into multiple specialized facilities, including the Center for Nanoscale Materials (CNM) and Materials Engineering Research Facility (MERF). Argonne's "Water + Al" initiative leverages Al to address many scientific challenges

relevant to the nexus between energy and water. Argonne recently announced the development of water filtration membranes that can clean themselves — which can be used by water treatment facilities or industry.

- UIC's proposed Institute for Water Research — Will focus on extracting energy from water, selective separation and conversion of contaminants and feedstocks, computational expertise in materials design and data science, metabolic flow modeling of the waterenergy-waste nexus, life cycle cost and impact analysis of technology innovations, and natural resource policy and planning.
  - University of Illinois Urbana-Champaign — Expertise in chemical phosphorus recovery from wastewater treatment plants and grain processing facilities, bio-electrochemical sensing and applications of AI at wastewater treatment plants, electrochemical technologies for energy-efficient selective separations and wastewater treatment, including nutrient recovery (N and P), and remediation of emerging contaminants.
- Marquette University (MU) and the University of Wisconsin — Milwaukee's Water Equipment and Policy Center (WEP) creates new sensors and devices, novel materials, innovative systems, and water policies to manage acutely stressed global water resources. Research strengths include point of use and point of entry technologies, emerging contaminants, sustainability, reduced energy consumption, biotech and used water energy recovery and the "internet of things" for the consumer, industrial, and municipal markets.
- UWM Great Lakes Genomics Center Applies genomics to issues of freshwater management.

 MWRD — Operates the largest nutrient (phosphorus) recovery facility in the world, with the annual capacity to remove 1,500 tons of phosphorus and convert it into a slow-release fertilizer.

The region's universities and research labs produce leading-edge research in the water sector, particularly leading efforts around molecular engineering and genomics as it relates to water production, purification and preservation; resource recovery; and data-driven modeling and AI, and their application to nutrient recovery, biogas generation, biosolid use, and water treatment. These areas of focus provide enormous potential for tech transfer and commercialization of products that can grow our region's water cluster and be exported across the world. As of 2020, Illinois ranks 8th in industryfunded research at institutions of higher learning, with businesses providing \$169 million in support.<sup>61</sup>

As of 2020, Illinois ranks 8th in industryfunded research at institutions of higher learning, with businesses providing \$169 million in support.



#### **Private Sector Innovation**

A region's capacity to develop and commercialize technologies is dependent on assets like universities and research labs as well as private sector investments in R&D. In 2019, private companies in Illinois spent \$14 billion in R&D expenditures, ranking #9 out of all states.<sup>62</sup> About 95% of all business R&D expenditures were paid by private companies, 0.5% by Federal sources, and 4.6% by non-Federal sources.<sup>63</sup> This suggests that Illinois has a robust private sector R&D ecosystem. According to the Illinois Science & Technology Coalition, as of 2022, Illinois ranks #10 out of all states for R&D activity at universities, federally funded R&D centers (FFRDCs), businesses, and other entities.<sup>64</sup>

The level of venture capital investment in a region also plays a role in supporting innovation, particularly for early startups. In the Illinois water cluster, six companies received \$69 million in funding in 2021 (see Table 5).<sup>65</sup> Although a small sample, this set of companies reflects longstanding and emerging strengths, from manufacturing to specialized sensors and cloud-based platforms.

#### TABLE 5

### IL Water Cluster, VC Investment in 2021

Company	Transaction Name	Money Raised (2021)	Description	Location
120Water	Venture Round	\$4,500,000	120Water is the end-to-end solution used by water professionals across the country to manage critical lead and drinking water programs. Comprised of secure cloud-based software, services and point of use kits, 120Water's solution provides tailored workflows for complying with lead and water quality programs that protect public health.	Chicago Zionsville, IN
Varuna	Angel Round	_	Varuna provides alerts, recommendations, and predictions to help water utility leaders to effectively manage a water system.	Chicago
Stemloop	Non Equity Assistance	_	Stemloop is a cell-free biosensors platform designed to create sensors that operate outside of cells. The sensors can detect a range of water contaminants, including antibiotics, small molecules and metals. Applications include municipal water supplies.	Evanston
	Funding Round	_		
Rheaply	Venture Round	\$2,200,000	Rheaply provides a platform that enables organizations to exchange materials and resources effectively.	Chicago
	Series A	\$8,000,000		
Intellihot	Venture Round	\$50,000,000	Intellihot manufactures tankless water heater systems for residential and commercial applications.	Galesburg
Serionix	Venture Round	\$4,800,000	Serionix is a research and development company that develops materials for water and air purification.	Champaign
	TOTAL	\$69,500,000		

Patent activity is an indicator that can provide insights on the scale and type of innovation occurring in a region. According to 2017 data, in terms of patent applications filed across all industries, Illinois ranks #14 out of all states (see **Appendix A**), followed closely by Wisconsin. Although Illinois is one of the top-ranking states, its patent activity lags behind top performers like Massachusetts and California.

#### Illinois is often one of the top 10 states in terms of patent filings for water technologies in the past 10 years.<sup>66</sup>

A broad patent search<sup>67</sup> for different types of water technology applications and technologies reveals strengths in water treatment, inventions incorporating sensors, and pumps (see Tables 6-10).



## TABLE 62010-2021 Patents: Treatment

	State	Number of Water Technology Patents: Treatment (2010-2021)
1	Texas	397
2	California	225
3	New York	116
4	Pennsylvania	110
5	New Jersey	106
6	Illinois	103
7	Minnesota	84
8	Florida	81
9	Michigan	76
10	Ohio	70

## TABLE 7 2010-2021 Patents: Sensors

	State	Number of Water Technology Patents: Sensors (2010-2021)
1	California	239
2	Texas	160
3	Illinois	99
4	New York	97
5	Michigan	80
6	Massachusetts	65
7	Wisconsin	62
8	Minnesota	54
9	Florida	46
10	New Jersey	45

#### TABLE 8

### 2010-2021 Patents: Pumps

	State	Number of Water Technology Patents: Pumps (2010-2021)
1	California	173
2	Texas	133
3	Michigan	95
4	New York	87
5	Illinois	82
6	New Jersey	69
7	Wisconsin	67
8	North Carolina	67
9	Minnesota	56
10	Delaware	54

## PATENTS, AT A GLANCE

A broad patent search for different types of water technology applications and technologies reveals strengths in water treatment, inventions incorporating sensors, and pumps.

#### TABLE 9

## 2010-2021 Patents: Filters

	State	Number of Water Technology Patents: Filters (2010-2021)
1	California	169
2	New York	96
3	Texas	88
4	Minnesota	80
5	Michigan	73
6	New Jersey	70
7	Florida	65
8	Delaware	56
9	Illinois	47
10	Pennsylvania	43

#### TABLE 10

## 2010-2021 Patents: Pipes

	State	Number of Water Technology Patents: Pipes (2010-2021)
1	California	30
2	Texas	22
3	New York	15
4	Pennsylvania	15
5	Illinois	12
<b>5</b> 6	Illinois Wisconsin	<b>12</b> 12
5 6 7	IllinoisWisconsinColorado	12       12       11
5 6 7 8	Illinois       Wisconsin       Colorado       Florida	12       12       11       8
5 6 7 8 9	IllinoisWisconsinColoradoFloridaNorth Carolina	12       12       11       8       8

#### TABLE 11

## Water Technology Companies Filing Patents between 2000-2022

Company	Number of Patents
Nalco Water	82
Intellihot	26
Culligan International Company	17
Aqua-Aerobic Systems, Inc.	14
Ecolab USA Inc	14
Schneider Electric Buildings	8
UOP LLC	5
Dober Chemical Corporation	4
Aquion, Inc	3
Heritage-Crystal Clean	3
Everpure, LLC	2
Nano Gas Technologies Inc.	2
Semler Industries Inc.	2
Serionix, Inc.	2
Air Diffusion Systems	1
ANDalyze, Inc.	1
Aqua Control Inc	1
Backflow Solutions, Inc	1
Cerro Flow Products	1
Deere & Company	1
Gasvoda and Associates	1
Hydro Flow Products	1
International Valve Manufacturing	1
LiquiTech	1
Natural Science	1
Opencel LLC	1

Taking a closer look at patents filed by Illinois water technology companies<sup>68</sup> reveals further insights. A total of 196 patents were filed between 2000-2022 by 26 companies (see Table 11) — focusing on industrial uses (see Table 12) and treatment (see Table 13). Private sector patent activity in Illinois is driven by eight large companies; the remaining have between 1-3 patents. There were a total of 20 patents, filed between 2001-2022, that contained an automatic element — incorporating the use of sensors and measuring devices to track and/or collect data to process and enable automatic decisions.



#### TABLE 12

#### Patents, by Sector

Sector	Number of Patents
Residential	35
Commercial	36
Industrial	117
Municipalities	22
None specified	36

Note: There is overlap.

#### **TABLE 13**

### Patents, by Categories

Category	Number of Patents
Treatment	41
Heating/Cooling	27
Oil/solid/water separation	16
Microbial/Biological Control	16
Corrosion Control	14
Control (controlling water flow - direction, amount)	13
Anti-Fouling	13
Monitoring	11
Contaminants/impurities	10
Detection	9
Control/Maintenance of water systems	7
Oxygenation/Aeration	6
Water Removal/Dewatering	5
Water Quality	4
Heavy Metals	4
Water Transport	3
Area: Includes Plumbing Systems	3
Clarification (coagulation, flocculation and sedimentation)	3
Fluid/Water Recovery	3
Water Pressure	1
Nutrient Removal	1
Pressure	1
Water-Energy Nexus	1



Illinois private sector patents have developed new innovations across several categories that are experiencing growth globally (see Global Markets section):

- **Treatment and Monitoring** Treating water, monitoring for potential issues that can affect water quality (including microbes, corrosion, and fouling); filter technology (filtering out metals, particulate matter, organic and inorganic contaminants, oils, process contaminants).
- **Monitoring** Detecting specific contaminants in the water (ranging from organics like sugar to metals like copper).
- Water Infrastructure Components and Assemblies – New assemblies for control valves, filters, and sensors; singular parts that are incorporated into apparatuses, assemblies, and systems; home and business water treatment systems such as water softeners and filtration systems.
- Data in Water Systems Communication systems that control water systems.



196 patents focusing on industrial uses and treatment were filed between 2000-2022 by 26 companies between 2000-2022 by 26 companies

#### **Small Business Innovation**

Another measure of innovation, particularly among small businesses, can be assessed through SBIR and STTR grants. Between 2010-2022, Illinois received 53 SBIR/STTR awards (\$17M) for water technologies and Wisconsin received 27 (\$9M) — comprising 3-4% of all SBIR/STTR awards. Some companies received more than one award (Table 14). By comparison, Massachusetts, which has a more established water sector, received 130 awards (\$42M) — indicating that there is room for growth in innovation and commercialization within Illinois.

In Illinois, 28 of awards went to companies with affiliations with University of Illinois at Urbana-Champaign. There were 13 awards that focused on water/wastewater treatment, and 11 awards that focused on contaminants in water.

#### **Barriers to Commercialization**

While Illinois has incredible research strengths — its ability to commercialize research, among both universities and entrepreneurs — could be improved. Interviews with water industry stakeholders revealed challenges that the region can address, particularly for treatment and monitoring technologies, to improve commercialization and adoption of new products. These include:

- Need for patient capital,<sup>69</sup> given long commercialization times, to help collect data and prove out a concept, and implement new solutions at scale.
- Access to pilot sites or some way to acquire test data for new technologies.
   Pilot sites can fill a gap between research conducted in universities and laboratories

#### TABLE 14

## Companies That Received More Than One SBIR/STTR Award

Company	Number of Awards
Serionix, Inc.	6
ANDalyze, Inc.	4
Eden Park Illumination, Inc.	4
Advanced Diamond TechNologies, Inc.	3
Dioxide Materials, Inc.	3
Cbana Laboratories	2
EP Purification, Inc.	2
Fluidic microControls, Inc.	2
NuMat Technologies, Inc.	2
QuesTek Innovations LLC	2

and commercial-scale development. Wastewater treatment facilities and industrial users are reluctant to buy new technology if there is no evidence of it working in a real-world scenario,<sup>70</sup> and even better working for their specific application.

 Technical assistance in establishing viable business and operational plans, particularly for scientists and engineers who have developed a new technology but do not have business experience to assess its marketability.

Given the increased interest from investors and private-sector in water-related innovations (both traditional and tech-enabled),<sup>71</sup> there may be momentum to increase innovation capacity and its adoption into the market.

## Workforce



Water workers fill a variety of jobs, with many of them concentrated in the skilled building trades, including plumbers, pipefitters, welders, electricians, and construction supervisors. In the Chicago region, many of these jobs, especially on public infrastructure projects, are unionized positions with family-supporting wages, benefits and opportunities for advancement. The Illinois Department of Employment Security (IDES) estimates that about 6,000 construction workers will be needed annually in Cook County, due to industry growth as well as retirements and attrition.

However, there is an opportunity gap in accessing these jobs. For example, of all registered apprentices in Chicagoland in the construction industry from 2015-2021, just 3.9% were women and just 8% were African American; only 6% of pipefitters and plumber apprentices were African American. African Americans also complete registered apprenticeship programs at a rate of only 31%, compared to 52% for white apprentices.<sup>72</sup> There is a limited supply of minority and female apprentices and journey-level workers due to a variety of reasons, including a lack of knowledge in communities of color about different trades and how to enter them; complicated and difficult to navigate entrance requirements for apprenticeship; and racist, sexist or otherwise hostile work environments that lead some workers to leave the industry.

With an aging workforce, well-paying jobs with opportunities for advancement, and lower formal educational requirements for many jobs, water utilities are an excellent opportunity for those seeking a middle-skill job.

However, the industry is disproportionally



white and male; in 2020, 94.2% of water and wastewater treatment plant and system operators were male and less than 8% were African American nationally.<sup>73</sup> **As retirements accelerate in public utilities, there is an opportunity to rebuild our water workforce in a more equitable and inclusive way.** 

In 2021, Congress passed the Bipartisan Infrastructure Law, which included funding for the single-largest investment in domestic water-related activities in U.S. history, totaling more than \$50 billion, including funding to eliminate lead service pipes across the country. These funds will be distributed through the EPA's water infrastructure programs, including the Drinking Water State Revolving Funds (DWSRF) and the Clean Water State Revolving Funds (CWSRF). For the state of Illinois, the Public Water Supply Loan Program, and the Water Pollution Control Loan Program are the respective counterparts to receive these funds. This investment means more infrastructure workers which, in Chicago, are generally jobs with family-supporting wages, benefits, and opportunities for advancement. Additionally, retirements and general shifts in employment in the pandemic area means that infrastructure jobs are plentiful.

Additionally, the Chicago and Milwaukee MSAs have employment concentrations in water-related industries, primarily in data processing, machinery manufacturing, chemical manufacturing, measurement device manufacturing, bolt/nut/screw/rivet/ washer manufacturing.

Across all water-related industries, those occupations that are currently experiencing high demand range from biological technicians, to machinists, to engineers, to general/operations managers (see Table 15). Occupations that are currently not picked up in the data, but may be required to drive continuous innovation in the region, are nanotechnology and genomics researchers. There will be opportunities to increase diversity within these high-growth careers pathways as strategies are developed. In developing strategies, note that educational requirements in the Chicago MSA are higher than the national average (see Appendix C), indicating the region has an opportunity to increase non-degree employment pathways in high-growth water careers.

To assess *existing* opportunities for inclusive career pathways, within the 10 largest industries in the Chicago MSA, occupations that pay above \$29/hour and have a positive growth projection from 2021-2030 are listed

#### TABLE 15

## Highest Demand Occupations in 2022 for the Blue Economy Workforce

Occupation
Architects, Except Landscape and Naval
Architectural and Engineering Managers
Biological Technicians
Chemists
Chief Executives
Computer Occupations, All Other
Computer User Support Specialists
Computer and Information Systems Managers
Construction Managers
Cost Estimators
Electrical and Electronic Engineering Technologists and Technicians
Electrical, Electronic, and Electromechanical Assemblers, Except Coil Winders, Tapers, and Finishers
Engineers, All Other
Environmental Engineers
Environmental Scientists and Specialists, Including Health
Financial Managers
First-Line Supervisors of Mechanics, Installers, and Repairers
General and Operations Managers
Hazardous Materials Removal Workers
Helpers-Installation, Maintenance, and Repair Workers
Helpers-Pipelayers, Plumbers, Pipefitters, and Steamfitters
Human Resources Specialists
Industrial Engineers
Industrial Production Managers
Janitors and Cleaners, Except Maids and Housekeeping Cleaners
Logisticians
Machinists
Maintenance and Repair Workers, General
Marketing Managers
Office Clerks, General
Personal Service Managers, All Other; Entertainment and Recreation Managers, Except Gambling; and Managers, All Other
Photographers
Project Management Specialists and Business Operations Specialists, All Other
Waldars Cuttars Soldarars and Brazars

Source: Intersect Illinois analysis

in Appendix C. Of these, the five occupations that do not require a Bachelor's degree are:

- First-Line Supervisors of Mechanics, Installers, and Repairers
- Mobile Heavy Equipment Mechanics, Except Engines
- Calibration Technologists and Technicians and Engineering Technologists and Technicians, Except Drafters, All Other
- Computer Network Support Specialists
- Plumbers, Pipefitters, and Steamfitters

These five occupations may provide the most inclusive pathways into the water cluster; of particular interest is "Calibration Technologists and Technicians and Engineering Technologists and Technicians"  as, interviews also emphasized the importance of technicians for the water workforce (particularly as the industry becomes more technology-dependent and complex; technicians who can troubleshoot a variety of problems will be important).

In addition to the growing workforce needs of emerging Blue Economy industries, near-term workforce needs have surfaced from trends including retirement cliffs in the trades, influxes of federal dollars for infrastructure replacement, and underrepresentation of women and people of color in existing water-related jobs. **Current opportunities for inclusive** workforce development include jobs in lead service line replacement, manufacturing, wastewater and drinking water operations, manufacturing, wastewater epidemiology and climate resilient infrastructure.<sup>74</sup>



## Assessment: IL and WI Opportunities

Around the world, several regions have begun to leverage their water-related assets through strategic investments to drive economic growth (see **Appendix B**). As demonstrated in both the Chesapeake region and the Midwestern states of Ohio, Kentucky and Indiana, regional water cluster organizations have helped to remove barriers to growth, for instance — by enabling collaboration between state regulators to develop cooperative agreements, allowing for reciprocity of new technology testing across multiple states.

The Illinois and Wisconsin region has the opportunity to similarly foster collaboration across innovation, finance, workforce and network in order to grow the water cluster deliberately and strategically. Current has the capacity to staff many of the recommended strategies for the Chicago MSA, and the Water Council has many existing initiatives with which the Chicago MSA region can align. Current builds relationships across research, government, utility, industry, and community organizations and can leverage its network to create additional programming with partners.

Some of the biggest opportunities in the region are:

- Accelerating commercialization of advanced treatment technologies
- Developing and manufacturing water efficiency technologies for export to water-scarce regions
- Expanding production and adoption of sensors and monitoring technologies technologies by matching products with end-users



- Growing and diversifying the workforce to meet employer demands for development and production of these products and services
- Linking research and development strengths with manufacturing and commercialization strengths across Illinois and in the Milwaukee region
- Leveraging manufacturing strengths to supply pipes and fittings to meet increased global demand

By 2030, Illinois will be home to a thriving and inclusive Blue Economy where water companies, corporate water users, utilities and research institutions collaborate to develop, manufacture, and distribute nation-leading treatment and monitoring technology, catalyzing environmental solutions and inclusive economic growth. Water cluster growth will be assessed by metrics including business revenue growth, BIPOC ownership growth, BIPOC employment growth, and others (see Implementation section).



## VI. Strategies to Fuel Inclusive Growth

To realize this vision, a set of high level, mutually re-enforcing strategies are presented below, designed to focus the Chicago region's resources on new opportunities within the water cluster. These strategies are also intended to ensure that inclusion is inherent in and drives all of the growth activity, focusing on four dimensions: employment, ownership, location (e.g., whether new growth is in or accessible to disadvantaged communities) and participation (in formal and informal organizations that drive growth).

The five inclusive growth strategies are:

- 1. Industry-led collaboratives
- 2. Employer-led workforce development
- 3. Testing, certification and demonstration center(s)
- 4. Business growth services programs
- 5. Manufacturing Initiatives

These strategies will be refined in the future into initiatives. As a guidepost in deciding on new water cluster strategies and interventions, the most successful cluster initiatives have five traits.<sup>75</sup>

- 1. Focused on establishing a robust ecosystem, not quick job gains
- 2. Industry-driven, universityfueled, government-funded
- 3. Placing a collective big bet on a regionally distinctive opportunity
- 4. Championed by passionate, dedicated leaders
- 5. Anchored by a physical center of gravity

## Industry-led Collaboratives

## **Overview**

Industry-led collaborative strategies should be designed to promote growth of a strong Blue Economy, enable the continuous innovation and commercialization needed to bring research to market, and build the region as a competitive global center for waterrelated innovation and product development.

This requires deliberately creating the synergies that make these collaborations succeed by efficiently connecting firms to researchers, entrepreneurs, workforce organizations, investors, suppliers, supporting industries, and data analytics. It also requires fostering collaboration across innovation, finance, workforce, etc. (e.g., develop a collaborative solution to lead service line replacement issue, which demands new technology and construction within centuryold systems).

The region has significant R&D strengths and is producing leading-edge water technologies that have the potential to be implemented in our region as well as exported to others to solve water challenges — but, to realize these opportunities will need greater connectivity between this research and industry, workforce programs, supply chains and networks.

## Recommendation and Relevant Models

The region's water cluster would benefit from greater industry collaboration in developing and implementing deliberate strategies to promote inclusive growth. Strategies and subsequent implementation activities must be informed and led by cross-sector and particularly private-sector partnerships. Current's role may be to strengthen inter-firm networks and cross-sector networks, and supporting these networks in development of strategies and subsequent initiatives.

In addition to addressing the strategies identified here, industry-led leadership tables will continuously identify new strategies as the market evolves, for instance by:

- Performing continuous market research to identify latest opportunities in a fastchanging sector
- Facilitating regulatory-industry collaboration (e.g., looking at liability of source of pollution and implementing greater accountability for the chemicals corporations produce from manufacturing processes)
- Supporting supply chain development to manufacture water technologies
- More deliberately connecting newer companies with specialty manufacturing services
- Identifying nutrient recovery streams and associated supply chains needed to support them — or, bolstering existing nutrient recovery programs (e.g., MWRD's phosphorus recovery and conversion to a slow-release fertilizer)
- Generating ideas to drive innovation (e.g., release RFPs for solutions to specific water quality issues in Chicago communities; run "hackathon" events to solve private sector water quality challenges)

Current has established activites already anchoring this work, including Chicago Water Week, ESG leadership activities, technology pilots, a research consortium, and blue jobs and education programs. The list above proposes strengthened market-based strategies to boost the inclusive Blue Economy. This requires efficiently connecting firms to researchers, entrepreneurs, workforce organizations, investors, suppliers, supporting industries, and data analytics.



For models of other industry-led organizations and their associated programming, see the Chicagoland Food and Beverage Network, a cluster organization that connects over 4,000 companies in the Chicago region to collaboratively drive innovation and growth a cluster organization that offers talent development, accelerator programs, and food safety training and space for food and beverage firms to colocate. For an example of industry-led innovation, see AB InBev, a global industryled incubator solving challenges including water stewardship, supply chain challenges, sustainable agriculture, and more. Or, for a water-related example, see Accelerate H2O in Texas which leads investor forums and industry roundtables, authors water technology reports, conducts cluster analyses, identifies opportunities for startups, and leads demonstration hubs.76 Models to inform the development of additional initiatives to drive innovation in the region include The Water Council's Tech Challenge and WaterStart Nevada's solicitation of applications for water technology companies that can address challenges identified by member organizations.

## Employer-Led Workforce Development

### **Overview**

Economic transformation has dramatically impacted labor markets. Particularly in the Blue Economy, the rise in innovation within a dated water infrastructure system and regulatory environment is leading to new occupations and technologies, along with shifts in how work is organized (for example, towards more outsourcing and independent workers). This requires new skills as well as continuous skills upgrading.

Water cluster products and services are varied and complex (e.g., ranging from reverse osmosis filters to PFAS sensors) meaning, it is very difficult for water sector employers to identify associated skill sets and project those that will be needed in the future. This leads to under-developed systems for efficiently upskilling incumbent employees, as well as a reliance on outdated credentials to assess potential employees that may not accurately reflect their skill sets. In addition, due to number of emerging technologies and services in the water cluster, associated career paths are also not as obvious to employees looking to enter the sector. Workers are not only hampered in their ability to identify job opportunities that match their skills (or that they could be qualified for with targeted training), but also to identify a career pathway in the first place.

There is opportunity to upskill workers for entrylevel through executive-level jobs. Interviews and market research to date have projected growing demand for occupations including:

- Operation and maintenance staff
- Engineers
- Technicians
- Trades
- Water technology manufacturing
- Nanotechnology and genomics researchers

Trainers and educators remain slow to respond to opportunities to teach in-demand skills in truly market- and employer-driven ways, still overly focused on legacy processes and programs (such as infrastructure replacement). All these actors are insufficiently connected through systems and platforms that can collect, analyze and share skills data to inform the effective functioning of the labor market. These labor market deficiencies, of course have an outsized impact on traditionally disconnected populations.77 Employer stewardship of workforce development will allow existing programs and pathways to better adapt to emerging needs as the Blue Economy grows.



## Recommendation and Relevant Models

Within the water cluster, there is a need to reform labor market systems to be more skills-based, responsive and targeted designed with the specific opportunities and challenges for women and people of color in mind. Employer-led, on-the-job training will likely be needed to create a workforce adept at innovating to develop new products, troubleshooting their implementation within dated water infrastructure systems, and using data collected to inform new actions and processes.

This strategy will align workforce skills with demand-driven occupations in high-growth, high-tech emerging water industries. It will increase avenues for labor force participation and develop clear paths for upward mobility.

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This strategy suggests convening sectorbased, industry-led employer consortia that collect market intelligence on talent demand, help design and lead responsive training programs and collectively develop means to update hiring practices. It is critical that companies are at the head of the table defining the agenda and co-creating relevant programs. These programs may include:

- **Market research** to outline high-growth near-term career pathways (e.g., civil engineers within water sector to complete large infrastructure projects)78 and longterm high-growth career pathways (e.g., intersections between water and public health; molecular engineering and nanotechnology scientists) in the water sector - and associated skills demand forecasting. This will help identify workforce with skillsets that can pivot to water-related careers.
- **Contextualized Training**, in partnership with community colleges, for these opportunities with curricula tailored to specific industries and their demand for specialized skills. This will lower degreebased barriers to entry in water-related careers. This may include continuous credentialing and on-the-job training for:
  - Technicians to troubleshoot issues on water systems that are increasing in complexity
  - Machinists to produce products
  - Cybersecurity coding skills to improve security alongside integration of data collection capabilities into water systems
- Blue Economy Academy offering training, certificates and degrees for all career levels. It could include skills-based training programs, stackable credentials, and innovative apprenticeship models.

The sector-based consortia model has preliminary efforts to build upon, such as the U.S. Chamber of Commerce Foundation's Talent Pipeline Management (TPM) Initiative which encourages assembling industry-led, sector-specific bodies to lead the charge on labor markets change. Applications of this model include TalNet, which brings cohorts of Michigan-area employers together to employ an evidence-based selection model around hiring based on skillset assessments. Additional examples include the Talent-to-Industry Exchange (TIE), managed by the Mid-America Regional Council (MARC) in Kansas City, which has helped assemble collaboratives in Skilled Trades, and the Manufacturing Roundtable in Milwaukee, a consortium of major regional manufacturers currently in the design phase of demanddriven workforce development programming.

In the near-term, workforce development programs for middle-skill jobs can help to meet existing needs caused by influxes of federal dollars for infrastructure, retirement cliffs in trades, and underrepresentation of women and people of color in water-related fields. In particular, current opportunities include lead service line replacement, manufacturing, wastewater and drinking water operations, manufacturing, water epidemiology and climate resilient infrastructure.

To support development of career pathways and closing opportunity gaps in water-related occupations by 2030:

Invest in pre-apprenticeship programs and barrier reduction funds that support opening opportunity to careers in the Trades for people from underrepresented groups. These pre-apprenticeship programs will help local trades unions, including plumbers and pipefitters, which are crucial to lead service pipe replacement, drinking water utility and

wastewater utility operations, diversify their apprenticeship classes and close gaps in opportunity. Connect these pre-apprenticeship programs to other industry employers in the water sector to help participants become registered apprentices in these valuable trades.

- Investigate partnerships with organizations like SkillsUSA Illinois to create US
   Department of Labor registered apprenticeships for water workers with local water departments or assist in scaling apprenticeship programs (see Evanston, IL as an example) with other municipalities.
- Connect community-based workforce development organizations to the expanding opportunities presented by lead service line replacement and other water-related infrastructure work, including field technician positions that require community-based workers. Work with utilities to expand relationships with community-based workforce development organizations to help them identify civilservice job opportunities for their clients.
- Illinois already has the right concentration of growing manufacturing industries to support growth of the water cluster, for example in automatic environmental control manufacturing, industrial valve manufacturing and pipe fitting manufacturing. Connect water-related employers to community colleges and trades programs [for example, Daley College and Jane Addams Resource Corporation (JARC)] manufacturing programs to help them meet the needs of employers and find quality jobs for graduates to support growth of people in manufacturing career pathways.
- Create additional career pathways connected to water quality sampling, including those in engineering and

Workforce development programs for middle-skill jobs can help to meet existing needs caused by influxes of federal dollars for infrastructure, retirement cliffs in trades, and underrepresentation of women and people of color in water-related fields.

the biological sciences and create additional career pathways in climate resilient infrastructure, including those in engineering or design. Partner with community colleges to develop certificate programs, where possible, and connect them clearly to degree programs.

 Investigate whether a social enterprise or transitional jobs program could be developed to encourage new entrants to the landscaping and maintenance of green infrastructure work.<sup>79</sup>



Consistent employer engagement in these strategies will allow programs to adapt to meet the changing skills needed by a growing Blue Economy and build on existing workforce development infrastructure.

Current has begun to undertake several workforce programs that work to bring employers to the table and increase awareness of Blue Economy career opportunities. These include Blue EDU STEM programs and other training programs recommended for federal funding. This programming can be expanded with further employer input.

## Testing, Certification & Demonstration Center(s)

### **Overview**

Stringent regulations within the water cluster mean that new products must first

be validated with test data (to de-risk their integration with a customer's processes; or, to certify to a certain standard). One of the barriers to scaling innovation in the water cluster is the lack of testing and validation resources for companies to bring new products to market. Substantial risks arise when a large company, for instance a food manufacturer, integrates a new water quality product into its processes. It poses a risk to its own products and their quality and presents a significant monetary investment. To combat this, cross-sector initiatives are needed that lower the risk and remove some of these barriers, specifically to:

- Accelerate market integration of new products with one another and with older systems
- Increase pathways to certification to different water standards
- Increase opportunities for entrepreneurs to develop/pilot products

## Recommendation and Relevant Models

Across the region, innovative water cluster companies need greater access to and availability of testing and validation resources. This may include access to flowing wastewater or surface-water streams to test a water technology, or access to an industrial facility (e.g., to test a new software's integration with a manufacturing process). This will facilitate the adoption and scale-up of innovative water products.

Testing and validation resources could be provided through:

- Facilitating cooperative agreements among companies that have developed a new product, and an industry or utility partner with the right processes or water streams on which to test the product. These agreements would state the partner's intent to assist in regional innovation efforts by allowing innovative solutions (that could one day be implemented in their water stream or processes, and are highly applicable to their industry) from smalland mid-sized enterprises to be tested or demonstrated at their facility.
- Providing a physical demonstration facility (or multiple facilities), given that each water technology is tailored to different industries/customers (e.g., purification products for pharmaceutical companies), or water streams (e.g., agricultural runoff), or areas of integration (e.g., within stormwater pipes; surface runoff).

Demonstration facilities could provide access to flowing water streams or could replicate specific industry processes, to accommodate the wide variety of testing and demonstration needs for water technology innovations.

As the network grows, it could also begin to document case studies, or gather those from other municipalities, to guide solutions to specific municipal or industrial water treatment and monitoring challenges.

Partners may include:

- Current the Current Research Consortium already includes a framework for supporting pilots across two major utilities and research universities. Current's H2NOW water-quality monitoring platform provides a test bed for sensors and other monitoring technologies in the Chicago River, and may be expanded to utilize new monitoring technologies and publicize test data.
- Water Quality Association At the association's Mirage Lab, companies book time on equipment to test their product on specialty water types (for a specific client, or to test against a new standard to achieve certification).
- Cleveland Water Alliance The Cleveland Water Alliance's Accelerator Testbeds support innovators in piloting and demonstrating their technologies in real world environments using a standard "pug-and-play" approach and providing innovators with legal and insurance support.



• The Water Council — their Pilot Program identifies specific sites for funded pilots (validation stage, not prototypes). Typical focuses are wastewater treatment, stormwater/green infrastructure or water quality.

Others are successfully implementing variations on this strategy: the Water Campus in the Netherlands (which emphasizes the importance of demonstration sites in scaling technologies), The Water Tower in Georgia (which offers a Demonstration Facility that provides access to 3 live wastewater streams from the treatment plant), and research from a 2019 study in Massachusetts<sup>80</sup> (which noted three key attributes of water technology demonstration centers: access to flowing wastewater and flowing surface-water streams; proximity to a research university; access to stakeholders and end users). If a future demonstration center is considered (rather than cooperative agreements with several sites), energy/building related demonstration site best practices may inform development (e.g., **ORNL** Building Technologies Research and Integration Center<sup>81</sup>).

## Business Growth Services Programs

### **Overview**

As mentioned in the Economic Framing section, economic growth occurs primarily through the growth of existing businesses, and next through entrepreneurship, followed by attraction of firms from elsewhere (which is enabled by support for existing businesses and entrepreneurship). Support for entrepreneurship and business growth generally is most successful when it's highly tailored to the circumstances of each firm. Tailoring support requires organizing and varying delivery of technical/financial assistance differently by stage of firm and by sector. Generally, earlier stage firms need more generic support (e.g. business planning, operating systems) and larger firms need more sector-specific expertise (e.g. technologies, specialized product and market development).

Supporting firms requires deep engagement, often best accomplished and delivered by coaches or mentors that have extensive practical experience in the same industry as the supported firm, and whom the businesses view as peers or more accomplished, and whom are able to assemble the right suite of additional resources to complement their mentorship (e.g., lawyers, finance experts, architects). Business support further has to combine technical support and finance, with finance normally following from technical support (e.g. developing growth plans for a business leads to identification of working capital needs). It requires building trust - by mentors listening to the firms' needs and responding to those, acting in the best interest of firms. In addition, it benefits from a longerterm relationship between firms and mentors that extends beyond the period of immediate technical/financial assistance. This model of business assistance is in contrast to historic small business walk-in centers, which provided similar resources to all businesses regardless of their specific needs (and did not have access to a specialized, tailored network of resources according to industry and stage of growth).

The water cluster is so varied in its products and services (see Figure 3) that each business needs highly tailored assistance to scale its products. For instance, just looking at sensors — each sensor tests for a different contaminant (e.g., PFAS, pharmaceuticals, pesticides) and may be applicable to varied customers (depending on the level of water purity that an industry demands). Companies developing these products will require specific assistance in identifying testing sites to validate their product, identifying customers,



**Economic** 

Growth

Growth of existing businesses

2 Entrepreneurship

Attraction of other firms

3



commercializing their product, and continuing to scale their business operations.

Startups and small firms in the water cluster cited a need for greater assistance in bringing their product to market and scaling operations. Individual business support can assist startups as well as small- and mid-sized enterprises (SMEs) in accelerating commercialization of R&D, in efficiently matching products with customers, and in scaling operations.

## Recommendation and Relevant Models

This strategy recommends a Business Growth Services Program to provide sophisticated business and finance support services to firms to enable them to scale-up their operations and grow into established companies. This will ensure products have not only anticipated the market (in a rapidly changing environment) but that entrepreneurs developing products go on to build successful companies.

Building this program will first require setting up the program infrastructure (e.g.,

staff including a Program Manager and "concierges" to field business support requests; a robust CRM system; a clear operational process). This program could build a network of mentors with expertise in water-related industries and company scaleup, a network of specialized services (e.g., lawyers, accountants, marketing professionals) and partner programs (e.g., cohort-based courses), and a network of startups and SMEs with growth potential. Concierges will screen businesses and match them with the right mentor. Mentors will begin with deep assessment of the particular firm's challenges and opportunities, and deliver services directly or with specialized services or partners that may include (but are not limited to):

- Business Planning work with firms to develop a robust business and operations plan;
- Management Advising services to address the major management challenges presented by growth, from establishing human resources functions to finding new talent to separating and organizing diverse business functions;

- Professional Services enhanced capabilities in financial management; legal and regulatory support; intellectual property; marketing and public relations; IT and web-based services; among others;
- Market Analysis and Acquisition

   custom market research services, understanding relevant supply chains, understanding and targeting potential customers, etc;
- **Product Development** support for R&D, testing, certifications, etc;
- Production support for the substantial re-working of production at much larger scale entailed by transition to scale-up: developing or expanding manufacturing capabilities and adapting new processes and technologies;
- Finance assist firms in identifying/ securing the specific form of working capital needed to scale, e.g., early-stage VC for commercialization, scale up fund (working capital), equipment financing for product adoption, or even Exchange-Traded Funds (ETFs), which invest in companies involved in the treatment and purification of water.

In addition, mentors could connect firms with specialized services and partner programs, such as:

- Specialized Services experts that can enhance firm capabilities in areas like financial management, legal and regulatory support, intellectual property, marketing and public relations, and IT and web-based services.
- Partner Programs industry partners, networks of similar firms, accelerators, and training programs. Building longerterm relationships with partner programs,



such as accelerators, also provides an opportunity to host sub-clusterspecific cohorts or union training shops to test good ideas (and implement in communities/regions of need), or to build a more robust mentorship network (with mentors who may be interested in working with mentees long-term).

The region has existing initiatives that a business growth services program could be modeled from, such as the Cook County Small Business Source<sup>82</sup> or the Southland Business Growth Services Program.<sup>83</sup> There are also several regional accelerators to which the program could facilitate connections (see Evergreen Climate Innovations and its Heartland Climate Tech Partnership at https://heartland-climate. org/resources-accelerators).

## Manufacturing Initiatives

## **Overview**

The Chicago region has the key competitive "ingredients" — from raw materials to workforce to manufacturing variety (metals, chemical, electrical) — to do larger scale manufacturing to support growth of the water cluster. Production of metal pipes and fittings is already a regional strength, but there is potential to increase production of water treatment and monitoring products as well. The COVID-19 pandemic has disrupted manufacturing and supply chains creating additional impetus for building new, integrated local and regional supply chains.

In particular, smaller companies making innovative water technologies — ranging from sensors to chemical treatment innovations — have cited difficulties in establishing manufacturing relationships (given that, often, niche specializations are needed to make the product, high levels of quality control are needed, and batch sizes vary).

Connecting the assets of existing hubs for manufacturers capable of manufacturing water technologies could assist in strengthening regional supply chains in the water cluster — and, matching manufacturers with water technology innovations in need of production. The range of regional fabrication firms and their collective capabilities offer a nucleus to realize these opportunities.

## Recommendation and Relevant Models

Manufacturing initiatives should address two near-term market opportunities:

 Collaborative supply chain development — Opportunity exists to develop and capture new supply chains and business attraction targets. Identifying such shared revenue opportunities and assembling competitive supply chains from Chicagoland firms will deliver new contracts and markets.

 Technology-enabled competitiveness — Assembling proactive, strategic supply chains can both capture growing markets beyond what individual firms can deliver and also create the business driver and monetary catalyst to invest in enhanced production approaches. ROI-driven, holistic technology integration support and training will enable the right suite of solutions to win immediate business and drive productivity and profitability — at the production worker, firm, and region levels — into the future.

These initiatives should provide services including but not limited to:

- Create a center of gravity for manufacturers
- Identify manufacturers with capability to provide the specialized, niche manufacturing needed for products like sensors
- Assemble manufacturers to collaboratively bid on RFPs for water technologies
- Assist companies in identifying the right customized manufacturing solutions for their products, inclusive of 3D printing opportunities
- Increase government connections to local pipe manufactures

Models that can guide the creation of this initiative include mHUB, Southland Metals Hub<sup>84</sup> and models for wraparound services to build the strength of a manufacturing initiative include the MxD Cyber Resource Hub.<sup>85</sup>

## **Next Steps**

In each of the strategies proposed, next steps involve assembling a group of stakeholders to define and lead specific programs. In some cases, Current may act as the lead, in other cases the facilitator, and in other cases may provide staffing support to move the strategy forward and pass it to another organization or collaborative. For instance, Current's role may be to strengthen inter-firm networks and cross-sector networks, and support these networks in development of strategies and subsequent initiatives - or, assemble a network of partners (e.g., to launch a Business Growth Services Program or to create a network of testing and demonstration partners).

Current's existing initiatives, including Chicago Water Week, ESG leadership activities, technology pilots, a research consortium, and blue jobs and education programs have created a foundation for economic growth. Now, Current can expand this programming to include the marketbased strategies identified in this report, and leverage the work of partners across the region to build additional programs.





## **VII.** Implementation Goals

The set of mutually-reinforcing strategies are designed to work together to grow the water cluster. Long term success may be measured by increase in gross regional product (GRP) specifically within the water cluster — which includes increases in business revenue, income and assets; increases in number of companies (start-ups and in-movers); increased market share of the water cluster; ownership increases by people of color; and increase in median incomes.

Working towards this goal, to measure impact by 2030, metrics are proposed to track collective progress of the strategies:

#### **Programs and Communications**

- New programs launched
- Funding received
- Media coverage of program activities

#### Leadership/Partnerships

 Number of overall partners participating in strategies

- Levels of partner commitments of time, money, other resources
- Diversity of partnerships

#### **Program inputs**

- Businesses receiving technical assistance
- Businesses receiving financial assistance
- Financial products launched
- Businesses utilizing testing, certification or demonstration center services
- Products connected with manufacturers (or vice versa)

#### Program outputs

- Business revenue growth
- Business productivity increases
- BIPOC ownership growth
- Employment growth (including BIPOC %)
- Improvements in BIPOC wages and occupations (career path progression)

# VIII. Conclusion

**By 2030,** the Chicago region will be home to a thriving and inclusive Blue Economy where water companies, corporate water users, utilities and research institutions collaborate on developing and manufacturing nationleading treatment and monitoring technology, catalyzing environmental solutions and inclusive economic growth.

This strategy is a blueprint meant to inspire action across all parts of the Blue Economy, including civic and nonprofit organizations, companies that identify as part of the water cluster itself (who develop and provide water technologies, products and services), those who provide input and support to the water cluster, and the end users that drive demand for better water products and strategies. By implementing targeted inclusive economic programs now, we can grow a globally significant Blue Economy here in Illinois and the Great Lakes Region by 2030.

With the right leaders at the table, Illinois can create transformational economic growth while also prioritizing climate resilience and environmental stewardship. The region stands to benefit from business growth and attraction, more diverse business ownership, investment, exports, patents and innovation, all while solving the water challenges that affect people here in the Great Lakes Region and around the world. Cross-sector alignment and collaboration is essential — this vision can't be achieved by any sector alone.

Now is the time to build an inclusive Blue Economy in Illinois. Let's do it together.



# IX. Acknowledgments

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# X. Appendix A supporting data

#### **FIGURE A1**

### Chicago MSA (Excluding Cook County): 2019 LQ vs 2010-2019 Growth in LQ



Notes: The size of bubbles represent employment concentration; Black arrows indicate those that are "off the chart;" Rest of Chicago MSA reflects the IL and WI portions of the Chicago MSA, exclusing Cook County; All other pipeline transportation, sewage treatment facilities, and carbon and graphite product mfg. are not shown because the industries had 10 or fewer jobs in 2019; Reflects private sector jobs only; Cook, Rest of MSA, and Rest of IL bubbles are at the same scale on size basis

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Source: dF-QCEW

#### **FIGURE A2**

## Milwaukee MSA (Excluding Milwaukee County): 2019 LQ vs 2010-2019 Growth in LQ



Source: dF-QCEW

**D** Carbon + graphite product mfg. (49%, 6.1)

#### TABLE A1

## Patent Applications Across All Industries

	State	Patent Applications per 10,000 Residents
1	Massachusetts	23.65
2	California	22.13
3	Washington	22.13
4	Oregon	15.42
5	Minnesota	15.12
6	Connecticut	14.95
7	New Hampshire	13.59
8	Utah	12.31
9	Michigan	12
10	New Jersey	11.23
11	Colorado	10.82
12	Vermont	9.54
13	New York	9.5
14	Illinois	8.41
15	Wisconsin	8.34
16	Idaho	8.33
17	Ohio	8.26
18	Rhode Island	8

## XI. Appendix B GLOBAL SCAN OF WATER CLUSTERS

## Current: Chicago's Water Innovation Hub Organization

Current is Chicago's water innovation hub. Their mission is to grow Chicago and Illinois' Blue Economy — the companies developing innovative water technologies and industries that use them - to build solutions that will solve the world's water challenges. Launched in 2016, Current is a local collaborative that leverages partnerships with the state's world-class utilities, research institutions, industries, and innovation community to achieve global environmental and economic impacts. As a cross-sector connector of local and global water sector stakeholders, Current builds networks, organizes events and convenings, and helps develop pilot projects to demonstrate new technologies in real-world settings.

Current helps solve the region's persistent water issues by identifying promising technological solutions from around the world and connecting them with end users, including industry and utilities. In light of the COVID-19 global pandemic, Current's work is even more essential. Current stays abreast of emerging research and technologies to help partners adapt and innovate, and is heavily invested in working to keep water in focus for state and local policy communities by making the Blue Economy a pillar of economic recovery. In Chicago and Illinois, Current believes that the Blue Economy presents significant opportunities for collaboration, innovation, and growth, leading to a more resilient economy. There is a clear need to capitalize on the region's potential to grow

companies and jobs in a set of industries that offer the possibility of improving management and stewardship of one of Chicago's most precious natural resources.

## National Water Clusters and Initiatives

Other regions are spearheading various waterrelated initiatives around the world. Each of these regions has taken a different approach to defining the water sector (e.g., ranking by priority; US Cluster Mapping Project data, etc.). Several notable sectors, organizations, and initiatives are listed below. Please note, this list is not exhaustive, and many programs are rapidly evolving — but this is meant to provide a few illustrative examples.

## The Water Council (Wisconsin)

## Water Sector definition: The Water Council's water cluster is technology-

**based**, focused on firms in water technologies involving instruments, equipment, and services. Their definition of the water cluster excludes water users, water and wastewater utilities and service providers. They also focus on water stewardship, connecting corporations of any size and industry with the resources they need to mitigate their water risk.

Methodology to define water sector: A comprehensive market analysis was conducted.

**Mission/Vision:** The Water Council is "dedicated to solving critical global water

challenges by driving freshwater innovation and advancing water stewardship."

#### Key Strategies/Initiatives:86

- Brew 2.0 Post-Accelerator A nextstage post-accelerator created to help late-stage startups build connections and grow their company's capacity. This virtual and in-person hybrid program focuses on expert-led sales and growth training along with a pitch event, all tailored for water tech businesses.
- Tech Challenge Empowers anyone with a freshwater technology innovation to vet their concept with industry professionals from leading corporations. Twice per year, our corporate sponsors — some of the largest water technology companies in the industry — select challenge topics, review applications and select finalists. Finalists present their solutions to the sponsors to compete for a cash prize, as well as an opportunity to work with a sponsoring corporation to turn their innovation into a viable commercial product.
- Pilot Program Helps water technology innovators from around the world bridge the gap from prototype to real-life application by facilitating in-field piloting. The program provides technical support services, funding and potential sites to help validate cutting-edge products and move them forward.

## University Research Corridor (Michigan)<sup>87 88</sup>

Water Sector/Initiative Scope: Water-related research topics include Core Water Products Services (CWPS), Water-Enabled Industries (WEI), and Water Infrastructure. The University Research Corridor (URC) highlights the role that the universities play in advancing waterrelated research and innovation. Michigan's water-related jobs are in water-enabled industries such as agriculture, mining and manufacturing; about 138,000 are in core water products and services producing water treatment facilities and solving water quality and quantity issues.<sup>89</sup>

**Mission/Vision:** URC supports waterrelated research and programs — to support Michigan's economy and quality of life, and position the state as a knowledge resource for water resources.

**Key Strategies/Initiatives:** Select initiatives include: The Infrastructure Network for Water (INH2O).

## Nevada's Office of Economic Development (GOED)<sup>90</sup>/WaterStart

Water Sector/Initiative Scope: Water technology, focused on:

- Water efficiency
- Water innovation

**Methodology to define water sector:** Priority industries were ranked, highlighting water efficiency and innovation as the greatest potential to inform workforce strategies to grow the water technology sector.

**Mission/Vision:** As fresh water becomes increasingly scarce, water resource management and sustainability will be vital to maintaining quality of life and economic development in communities around the world. WaterStart aims to scale new solutions to water challenges, accelerating the development and adoption of innovative water technologies.

**Key Strategies/Initiatives:** WaterStart is the key initiative resulting from GOED's water technology research, and the organization runs various programs (e.g., connecting technology companies with water managers to scale water-related companies).

## Accelerate H2O (Texas)<sup>91</sup>

Water Sector/Initiative Scope: The initiative focuses on water technologies that solve challenges for residential, commercial, agriculture and public utility end-users. Sub-clusters of focus include construction, manufacturing, operations, and wholesale distribution of water products/services.

**Methodology to define water sector:** The initiative used quantitative methods from the US Cluster Mapping Project to define the water cluster and highlight sub-clusters.

**Mission/Vision:** Accelerate H20 was developed to be a national driver for innovating, demonstrating, and partnering in resiliency — solving water-related challenges facing Texans and leveraging opportunities for economic growth.

**Key Strategies/Initiatives:** AccelerateH20 has led to other initiatives (e.g., ResilientH20; Resilience Innovation Hub), and has in the past helped launch initiatives like investor forums, industry roundtables, and demonstration hubs.

## BlueTechValley Initiative (California)<sup>92</sup>

Water Sector/Initiative Scope: The initiatives focuses on water and energy-oriented firms, centered around industries:

- Industrial, Ag & Water
- Renewable & Power Generation
- Energy Technology Systems

**Mission/Vision**: The region's "water-scarce climate fuels the need for extreme water efficiency, making it the ideal place to test, develop, and commercialize new technology."

**Key Strategies/Initiatives:** Select initiatives include: BlueTechValley Plans, Valley Ventures (business accelerator program), Technology Innovation Evaluation, UC Davis Big Bang! Business Competition.

## Cleveland Water Alliance<sup>93</sup>

development of new technologies.

Water Sector/Initiative Scope: The Cleveland Water Alliance focuses on the expansive regional "blue economy," including clean water innovation, conservation and

**Mission/Vision:** The organization "seeks to better utilize the economic and job-creating potential of Lake Erie while also urging greater care of our valuable, natural asset." It does this by building "upon Ohio and the Great Lakes' assets and resources to create a clean water innovation ecosystem that harnesses technology, spurs the economy, enhances education and drives research."

**Key Strategies/Initiatives:** Select initiatives include: Water Accelerator Testbeds, Open Innovation Challenges, Freshwater Innovation Fund.

## TMA BlueTech (California)<sup>94</sup>

**Mission/Vision:** TMA BlueTech "brings education, policy and technology resources together to promote innovation and economic development in the Blue Economy" and "promotes sustainable, science-based ocean and water industries."

**Key Strategies/Initiatives:** Programming ranges from education and workforce development to exports to building the BlueTech ecosystem. Select initiatives include: BlueTech Week, BlueTech Global Connect webinar series.
## Water Tower (Georgia)<sup>95</sup>

**Mission/Vision:** The Water Tower aims to create "a thriving ecosystem of water innovation fueled by imagination, informed by research, and powered by pioneers. This is being accomplished by bringing together the public and private sectors of the water industry, side by side with academia and nonprofits, to tackle the industry's greatest challenges."

**Key Strategies/Initiatives:** Programming ranges from applied research to technology innovation to workforce development.

## Massachusetts Clean Energy Center<sup>96</sup>

#### Water Sector/Initiative Scope:

Massachusetts Clean Energy Center (Mass CEC) focuses on the water-energy nexus — "the relationship between how much water is used to generate and transmit energy, and how much energy is needed to pump, collect, convey, treat and store water."

**Mission/Vision:** The organization is "dedicated to accelerating the growth of the clean energy sector across the Commonwealth to spur job creation, deliver statewide environmental benefits and to secure long-term economic growth for the people of Massachusetts."

**Key Strategies/Initiatives:** Select initiatives include: Wastewater Treatment Pilot Program, Water Technology Demonstration Centers, Water Innovation Funding Opportunities.

### Washington Maritime Blue

Water Sector/Initiative Scope: Washington Maritime Blue develops maritime business, technology, and practices through its comprehensive maritime strategy with an active innovation accelerator program, along with its independent cluster organization which works to accelerate maritime innovation and sustainability.

**Mission/Vision:** The organization is "committed to the development of maritime business, technology, and practices that promote a sustainable future contributing to economic growth, ecological health, and thriving communities."

**Key Strategies/Initiatives:** Select initiatives include: Innovation accelerator program, Youth Maritime Collaborative, Quiet Sound, Zero Emission Fast Foil Ferry, Tacoma Green Hydrogen, COVID-19 Early Detection for Fisheries/ Maritime, 5G Feasibility study Tacoma, West Coast Offshore Wind.

## SeaAhead (Massachusetts)<sup>97</sup>

#### Water Sector/Initiative Scope:

SeaAhead's focus is on the blue economy in Boston - a combination of maritime, cleantech and tech sectors.

**Mission/Vision:** SeaAhead brings together entrepreneurs, investors, industry leaders, and stakeholders to "produce scaleable commercial solutions to modernday challenges."

**Key Strategies/Initiatives:** Select initiatives include: Startup Platform, Blueswell Incubator, Blue Angels, Sea Ahead Ventures.

## Great Lakes Commission<sup>98 99</sup>

**Water Sector/Initiative Scope:** The Great Lakes Commission (GLC) focuses on the Great Lakes region – a \$6 trillion regional economy that holds 90% of the U.S. supply of fresh surface water. It estimates that more than 1.5 million U.S. jobs, generating \$62 billion in annual wages, are directly connected to the Great Lakes.

**Mission/Vision:** The GLC "recommends policies and practices to balance the use, development, and conservation of the water resources of the Great Lakes and brings the region together to work on issues that no single community, state, province, or nation can tackle alone."

**Key Strategies/Initiatives:** Select initiatives include: Aquatic Invasive Species Prevention and Control, Blue Accounting, Coastal Conservation & Habitat Restoration, Commercial Navigation, Economic Development<sup>100</sup> & Waterfront Community Revitalization, Water Quality, Water Management & Infrastructure, Information Management, Advocacy.

## CenterState NY: AM-TEC Initiative (New York)<sup>101</sup>

Water Sector/Initiative Scope: The initiatives focuses on manufacturers and suppliers of thermal and environmental control (TEC) equipment.

Methodology to define water sector: A comprehensive market analysis was conducted.

**Mission/Vision:** AM-TEC seeks to strengthen CenterState New York's thermal and environmental controls manufacturing sector (which serves, among others, energy and water sectors).

**Key Strategies/Initiatives:** This initiative is part of the region's broader economic development strategy and seeks to grow advanced manufacturing and clean energy and environmental systems.

## Oregon Business Council Water Task Force<sup>102</sup>

Water Sector/Initiative Scope: The Water Task Force published a 2022 report highlighting the need to upgrade Oregon's water laws, policies and practices to respond to changing conditions and priorities, among them increased pressure on groundwater and surface water availability, affordability channels, and inadequate water management systems.

**Mission/Vision:** The goal of the project and report is "to frame water management in a way that enables policy makers to discuss difficult but critical water issues, to apply widely accepted science, and to adopt a shared approach to modernizing Oregon's water management systems."

## Global Water Clusters and Initiatives

## Water Sector in Israel

**Water Sector definition**: The water sector, as defined by the Israel Export Institute, includes water treatment, water purification, wastewater treatment, water security, water management, desalination, filtering, irrigation, water recycling, and more.<sup>103</sup> Israeli Watertech is spearheading the shift towards sustainable water management through a broad range of technologies.<sup>104</sup> In Israel, water is a US\$2 billion industry, and growth has been rapid; the sector has seen an increase in exports of almost 200% in just three years.<sup>105</sup>

**Mission/Vision:** The Israeli government seeks to turn severe water scarcity into an economic opportunity with the right investments in technology, financing, policy, and institutions.<sup>106</sup>

**Key Strategies/Initiatives:** Various initiatives exist. Universities in Israel have already developed water research partnerships with universities in Illinois

including Northwestern University and University of Chicago. The water sector's growth is also sustained by the country's progressive approach to water pricing, which aims to promote water conservation while also ensuring that investments in water supply and delivery are sustainable, with operation and maintenance expenses financed by tariffs paid by water users.

### Water Sector in Singapore

**Water Sector definition:** Singapore's National Water Agency identifies three main sectors: water efficiency improvement, water treatment technologies, and water infrastructure. The country is home to 180 water companies with more than 20 water research centers spanning the entire water value chain.<sup>107</sup>

**Mission/Vision:** The Agency emphasizes integrated water management, seeking to become a Global Hydrohub — a "leading centre for business opportunities and expertise in water technologies."

Key Strategies/Initiatives: Select initiatives include: Mandatory Water Efficiency Labelling Scheme, Water Closet Replacement Programme, Water Efficiency Awards.

### **Netherlands Water Partnership**

Water Sector definition: The Netherlands Water Partnership (NWP) focuses on sectors including: climate resilience, finance for water, water and agrifood, water and crisis, and water technology.<sup>108</sup>

**Mission/Vision:** NWP works towards a future where over 9 billion people live well and in balance with the earth's resources – by creating "transformative, integrated and inclusive solutions for water-related challenges, creating positive opportunities for the planet and future generations."

**Key Strategies/Initiatives:** Select initiatives include: Partners for Water Programme, Water Support Programme, Water for Food Programme, Young Expert Programmes.

## XII. Appendix C supplemental jobs data

#### TABLE A2

### Occupations With Pay Above \$29/hour and Positive Growth Projection from 2021-2030

Within the 10 largest industries in Chicago MSA (as listed in Table 3)

Occupational Makeup (top 10 occupations)	Relevant to X water cluster NAICS	Employed in Industry (2021)	% Change (2021 - 2030)	Median Hourly Earnings	Typical Entry Level Education	Work Experience Required	Typical On-The-Job Training
Marketing Managers	2	391	37%	\$60.62	Bachelor's degree	5 years or more	None
Management Analysts	1	1,272	15%	\$43.71	Bachelor's degree	Less than 5 years	None
First-Line Supervisors of Mechanics, Installers, and Repairers	1	284	12%	\$35.29	High school diploma or equivalent	Less than 5 years	None
Market Research Analysts and Marketing Specialists	3	325	11%	\$30.62	Bachelor's degree	None	None
Construction Managers	1	1,020	10%	\$39.25	Bachelor's degree	None	Moderate-term on-the-job training
Mobile Heavy Equipment Mechanics, Except Engines	1	277	7%	\$31.26	High school diploma or equivalent	None	Long-term on-the-job training
Computer and Information Systems Managers	1	555	4%	\$70.35	Bachelor's degree	5 years or more	None
Chemists	1	305	4%	\$35.00	Bachelor's degree	None	None
Computer Occupations, All Other	1	318	4%	\$43.22	Bachelor's degree	None	Moderate-term on-the-job training
Software Developers and Software Quality Assurance Analysts and Testers	4	1,003	4%	\$50.74	Bachelor's degree	None	None
Computer Systems Analysts	2	609	4%	\$44.35	Bachelor's degree	None	None
Industrial Engineers	1	171	3%	\$42.33	Bachelor's degree	None	None
Calibration Technologists and Technicians and Engineering Technologists and Technicians, Except Drafters, All Other	1	332	3%	\$32.65	Associate's degree	None	None
Electrical Engineers	1	754	2%	\$46.91	Bachelor's degree	None	None
Computer Network Support Specialists	1	358	2%	\$30.05	Associate's degree	None	None
Plumbers, Pipefitters, and Steamfitters	1	12,206	0%	\$43.17	High school diploma or equivalent	None	Apprenticeship

Source: Intersect Illinois analysis

# XIII. Appendix D NAICS

The "water cluster" has been defined as the following NAICS:

### TABLE A3 NAICS Water Cluster Definition

221310	Water Supply and Irrigation Systems
221320	Sewage Treatment Facilities
237110	Water and Sewer Line and Related Structures Construction
238220	Plumbing, Heating, and Air-Conditioning Contractors
325180	Other Basic Inorganic Chemical Manufacturing
325199	All Other Basic Organic Chemical Manufacturing
325211	Plastics Material and Resin Manufacturing
325998	All Other Miscellaneous Chemical Product and Preparation Manufacturing
326122	Plastics Pipe and Pipe Fitting Manufacturing
332722	Bolt, Nut, Screw, Rivet, and Washer Manufacturing
332911	Industrial Valve Manufacturing
332912	Fluid Power Valve and Hose Fitting Manufacturing
332913	Plumbing Fixture Fitting and Trim Manufacturing
332919	Other Metal Valve and Pipe Fitting Manufacturing
332996	Fabricated Pipe and Pipe Fitting Manufacturing
333318	Other Commercial and Service Industry Machinery Manufacturing
333914	Measuring, Dispensing, and Other Pumping Equipment Manufacturing
333996	Fluid Power Pump and Motor Manufacturing
334512	Automatic Environmental Control Manufacturing for Residential, Commercial, and Appliance Use
334513	Instruments and Related Products Manufacturing for Measuring, Displaying, and Controlling Industrial Process Variables
334514	Totalizing Fluid Meter and Counting Device Manufacturing
334516	Analytical Laboratory Instrument Manufacturing
334519	Other Measuring and Controlling Device Manufacturing
335991	Carbon and Graphite Product Manufacturing

### NAICS Water Cluster Definition, cont.

339999	All Other Miscellaneous Manufacturing
486990	All Other Pipeline Transportation
518210	Data Processing, Hosting, and Related Services
541310	Architectural Services
541320	Landscape Architectural Services
541330	Engineering Services
541380	Testing Laboratories
541618	Other Management Consulting Services
541620	Environmental Consulting Services
541690	Other Scientific and Technical Consulting Services
541715	Research and Development in the Physical, Engineering, and Life Sciences (except Nanotechnology and Biotechnology)
541990	All Other Professional, Scientific, and Technical Services
561210	Facilities Support Services
562910	Remediation Services
562998	All Other Miscellaneous Waste Management Services
811310	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance
813312	Environment, Conservation and Wildlife Organizations

## XIV. Appendix E Economic Framing

## The Next Economy

The global economy is undergoing a transformation that is fundamentally changing how productivity and growth occur. Knowledge assets embedded in technology and people are redefining how products are made, moved and sold across all sectors (not just "knowledge industries"). With the impact and value of knowledge greater than ever, human capital is solidifying its place as the single most important input for economic growth. A resulting more global, dynamic economy rewards continuous innovation, heightening the importance of rich, flexible cross-sector networks efficiently deploying and connecting human capital, business, technology and other assets. The pace of change in the economy is increasing: "creative destruction" is disrupting industries, occupations and places; while new products, firms, industries and markets are rapidly emerging, leading to enormous new wealth creation.114

One effect of these changes is that workers and businesses are experiencing ever greater benefits from locating close to each other, and thus are increasingly concentrating – and, more importantly, are more productive – in metropolitan regions. Metropolitan regions are dynamic, flexible and complex systems that nurture unique economies, which arise from an area's distinctive blend of industries, human capital, technologies, institutions and the built environment. Metropolitan areas have thus become the most important unit of geography in the global economy.<sup>115</sup> Each region's unique combination of assets, markets, institutions and culture creates a "whole greater than the sum of the parts." Each of the key dimensions — industry concentrations, labor pools, infrastructure — succeeds or fails within the context of the whole region. Therefore, strategies to grow an entire regional economy must be tailored to the region's distinct strengths and opportunities and should align across all aspects of the economy. There are no "onesize-fits-all" solutions for economic growth.<sup>116</sup>

## A New Approach to Economic Growth

The transformative nature of the next economy has major implications for the practice of regional economic development. Traditional strategies are no longer wellsuited to today's economic opportunities. Regions need a new approach, moving away from consumption-driven growth (e.g., retail, housing) and from deal-by-deal, opportunistic firm attraction efforts based primarily on lowering costs for companies.<sup>117</sup>

Instead, regions must try to create production-driven economies that compete by adding value, building on their unique assets, strengths and opportunities. To do this, regions must concentrate on increasing *productivity*. Successful regions are developing and implementing comprehensive, integrated and inclusive strategies across the five market levers (discussed below) that determine productivity.

At a high-level, the shift is from business development to economic development, from opportunistic deals to improving the economic system (which enables doing better deals). New practices emphasize:

• Competing on value added, instead of low-cost, becoming a place where firms and people are more productive because of better human capital, infrastructure, complementary firms, governance, and so forth. This makes the place "sticky," continually attracting more firms and people;

 Identifying unique strengths and "building from the inside out,"

recognizing that growth starts with *existing* assets: most net growth comes from a region's existing firms, followed by start-ups and only then by firms moving in. Firm attraction is the tail, not the dog, of economic development. Combined with the value-added principle, this means that initiatives should start by strengthening existing firms and industries and the assets which support them;

- Acting strategically through contextspecific, integrated solutions, rather than having disconnected, siloed programs (or chasing isolated "big deals");
- Focusing on inclusive, quality growth, looking for long-term value and wealth creation rather than short-term profit extraction and other unsustainable development models.<sup>118</sup> A fundamental tenet of quality growth — developing and deploying ALL assets — is inclusive growth. Quality growth should also include focusing on climate conscience opportunities to grow clean jobs and industries that are more efficient and less polluting.

These principles indicate that the regions which build from the inside out,

concentrating on their unique strengths, identifying their competitive advantages and then designing and launching marketbased, targeted, integrated growth strategies that leverage all of their assets, will be most successful in creating strong, attractive economies and communities, resulting in more sustainable growth.

## **Inclusive Growth**

A central aspect of today's economy is the "inclusive growth paradox." On the one hand, in the short term, growth in this economy is disrupting (and in some cases, wiping out) legacy industries and labor markets. This is contributing to the disappearance of the middle class and creating unprecedented wealth inequality.

On the other hand, in the long term, it is increasingly clear that the regions with less inequity grow more sustainably over time. They utilize the talent of more of their workers and companies, are more efficient and productive and reduce the costs associated with poverty.<sup>119</sup> Sustained growth is positively correlated with lower inequality and racial segregation and smaller differences in citysuburb poverty levels.<sup>120</sup> A central challenge - and opportunity - for new economic development practice then, is aligning inclusion and growth. Equity and growth may have conflicted in the industrial economy: regardless, they can and must be two sides of the same coin in the next economy.

A crucial aspect of inclusive growth is that it does not refer to separate inclusion practices, nor to traditional equity work, as important as those remain. Traditionally, growth has taken place and then the people and places left out have received some set-asides or redistribution. Inclusive growth does not separate inclusion from growth — it is one thing, not two — and instead is

a different approach to all growth. It seeks to fundamentally reposition disadvantaged people and places, particularly communities of color, as leading owners, drivers and beneficiaries of the enormous growth opportunities in the new economy in the first place, not after the fact.<sup>121</sup>

Inclusion generally occurs across four dimensions:

- Employment improving the functioning of labor markets so that workers of all skill levels and backgrounds are efficiently prepared, matched and upskilled for quality jobs with strong career ladders;
- Ownership growing BIPOC company ownership to generate wealth creation and capture, especially by finding opportunities in high growth industries, as well as real estate ownership in residential, commercial and industrial development;
- Location siting and supporting firms in places that are readily accessible to disadvantaged populations; and
- Participation ensuring diverse representation of all races, genders, backgrounds, national origins, etc., at the relevant private, public and civic sector "tables" where growth strategies and economic policies are shaped.

Quality, inclusive growth practices that increase the employment, ownership, access and participation of BIPOC communities in the region's emerging economic opportunities are essential to achieving lasting economic growth. Each of the growth strategies that have evolved from this plan have been shaped by the opportunities in those four avenues to inclusion.

## **Key Drivers of Growth**

In the new economy, five market levers (listed below and diagrammed in Figure A1) account for the efficiency and productivity of regional economies and drive how much complementary, concentrated assets realize synergies.<sup>122</sup> Together, they provide a framework for understanding a region's economic assets, challenges and opportunities.

This Strategy's market analysis will focus on clusters — in particular, the water cluster:

 Clusters — Industry-based concentrations of firms and related institutions that are more efficient and productive when colocated, due to lower transaction costs among buyers, suppliers and customers; sharing of labor pools and other common inputs; facilitating knowledge exchange; and enhancing the cluster's innovative capacity.

The analysis will also include examination of the other levers of growth as they relate to water cluster success: human capital, business, institutional and built environment all play roles in driving the performance of the water cluster.

 Human Capital Development and Deployment — Human capital is the most important asset in today's knowledge economy. Maximizing its impact requires better developing workers' skills to match emerging jobs and efficiently connecting workers to those jobs. This requires strategies such as changing employer hiring practices to emphasize skills over (often outdated) credentials, creating better means of matching workers with jobs and upskilling opportunities, and tailoring education and training to indemand skills in growing clusters.

### FIGURE A3 Five Market Levers for Economic Growth



- Innovation and Entrepreneurship The ability to innovate is the core driver of increasing productivity. In a more competitive, fast-paced, knowledgebased economy continual innovation, commercialization and business creation is crucial for economic success.
- **Spatial Efficiency** The relative location of businesses, suppliers, workers and consumers within a region (and the physical and virtual infrastructure that connects them) greatly influences efficiency and productivity. Co-location and connecting infrastructure determine the costs for moving goods, people and ideas, in turn enhancing or diminishing many economic benefits of agglomeration.
- **Governance** Not to be confused with government, governance encompasses all the institutions that foster economic networks, innovation and other activity. The increasingly dynamic economy places a premium on rich formal and informal networks that enable exchange of ideas and facilitate relationships, transactions and coordination across the public, private and civic sectors. While government plays a key role - shaping and enabling market activity and providing the public goods that enhance productivity and efficiency a broad range of civic, private-sector and cross-sector institutions are central to establishing an environment conducive to economic growth and fostering open, adaptive and flexible cross-sector networks.

These market levers influence each other. The point is to understand, based on a particular places' assets, where there are key intersections of firms (clusters), people (human capital) and technology (innovation) that — when connected by the right built and virtual environment (spatial efficiency) and institutional environment (governance) — will create the synergies that make the place most productive and thus competitive for certain industries, firms and people.

## **Cluster Theory**

Clusters drive regional economic growth by enhancing firm productivity through several mechanisms:

- Reducing transportation and infrastructure costs due to close proximity to one another;
- Enabling the development and sharing of specialized labor pools and other inputs common across firms;
- Providing firms more efficient access to customers, who may also be geographically concentrated (either as a cause or effect of firm clustering); and
- Facilitating innovation through "knowledge spillovers" — the informal learning and knowledge exchange that results from interactions between firms or the movement of employees between firms.

Industry clusters have existed in practice for centuries, but it is only within the last few decades that they have been called out as a particular way for regions to identify and build upon their competitive advantages. Michael Porter's work in this space helped to organize the components of a cluster (Porter's "Diamond Model"). It first describes the core cluster itself:

 Firm Strategy, Structure and Rivalry (Water Cluster) — This is the water cluster, which will be defined differently depending on what is clustering within each region (see Appendix B).

And, next — describes the components that lead to clustering and make a cluster competitive:

- Factor Conditions Inputs to the water cluster; this includes Lake Michigan, a strong workforce, and strong R&D output in water-related topics.
- Demand Conditions High-volume water users, which create demand for products and services within the water cluster. For instance: manufacturing, agriculture, food and beverage industries.
- P Related and Supporting Industries Suppliers and support services to the water cluster, such as data processing capabilities, chemists, or raw materials like plastics and metals.

# XV. Appendix F Acronyms

Active Pharmaceutical Ingredients (APIs) Network-as-a-Service (NAAS) Artificial intelligence (AI) North American Industry Classification System (NAICS) Black, Indigenous, and people of color (BIPOC) Oak Ridge National Laboratory (ORNL) Clean Energy Center (CEC) Office of Economic Development (GOED) Compound Annual Growth Rate (CAGR) **Oxidation-Reduction Potential (ORP)** Core Water Products Services (CWPS) Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) Customer relationship management (CRM) Pritzker School of Molecular Engineering (PME) Environmental Justice (EJ) Research and Development (R&D) Environmental, Social, and Governance (ESG) Request for Proposal (RFP) Exchange-Traded Funds (ETFs) Reverse Osmosis (RO) Federally funded R&D centers (FFRDCs) Science, Technology, Engineering and Foreign Direct Investment (FDI) Mathematics (STEM) Gross Domestic Product (GDP) Sewage Thermal Energy Use (STEU) Gross Regional Product (GRP) Small- and Mid-sized Enterprises (SMEs) Illinois Environmental Protection Agency (IEPA) Small Business Innovation Research Program (SBIR) Illinois Nutrient Trading Initiative (INTI) Small Business Technology Transfer (STTR) Lead Service Lines (LSLs) Software-as-a-Service (SaaS) Location Quotient (LQ) Talent Pipeline Management (TPM) Marquette University (MU) The Infrastructure Network for Water (INH2O) Membrane Bioreactor (MBR) Thermal and Environmental Control (TEC) Metropolitan Statistical Area (MSA) Total Organic Carbon (TOC) Metropolitan Water Reclamation District of Greater Chicago (MWRD) Ultrafiltration (UF) Microfiltration (MF) Ultraviolet (UV) Mid-America Regional Council (MARC) Water-Enabled Industries (WEI) Nanofiltration (NF) Water Equipment and Policy Center (WEP) National Pollutant Discharge Elimination Zero Liquid Discharge (ZLD) System (NPDES)

## XVI. Endnotes

- 1 A. Park Williams, Edward R. Cook, Jason E. Smerdon, Benjamin I. Cook, John T. Abatzoglou, Kasey Bolles, Seung H. Baek, Andrew M. Badger, Ben Livneh, Large contribution from anthropogenic warming to an emerging North American megadrought, Science, April 17, 2020 : 314-318.
- 2 Climate Central, "POURING IT ON: How Climate Change Intensifies Heavy Rain Events," May 15, 2019, https://www.climatecentral.org/news/ report-pouring-it-on-climate-change-intensifies-heavy-rain-events, accessed May 13, 2020.

#### 3 Promoting Technology Innovation for Clean and Safe Water

- 4 For example, strategies that have been developed in water sectors across the country include TitletownTech, an initiative to fund early-stage, high-growth businesses in five verticals (including "agriculture, water and environment") and the Port of San Diego's Blue Economy Incubator Program, an initiative to provide funding and support services to sustainable aquacultures and blue tech ventures.
- 5 https://www.un.org/regularprocess/sites/www.un.org.regularprocess/files/rokpart2.pdf
- 6 https://www.commerce.gov/news/blog/2022/04/earth-day-spotlight-our-ocean-our-blue-economy
- 7 https://myemail.constantcontact.com/Power-the-blue-economy-by-investing-in-the-BlueTech-multiplier. html?soid=1101747281980&aid=blA6bdlyROI
- 8 The degree of geographic proximity exhibited by firms in clusters varies widely from one cluster to another, ranging from a few blocks (e.g., Manhattan's garment district) to several states (e.g., the Great Lakes' auto industry cluster). For the purposes of this proposal, the primary unit of geographic reference is the metropolitan area, though the question is an empirical one: any given cluster will have a specific geography of its members, which will often be sub-regional in scale. Joseph Cortright, "Making Sense of Clusters: Regional Competitiveness and Economic Development," The Brookings Institution, March 2006, 6.
- 9 Cortright, "Making Sense of Clusters."
- 10 A cluster can consist of hundreds or even thousands of firms of various types and sizes from Fortune 500 corporations and large professional service firms (e.g., advertising and accounting businesses) to highly specialized R&D operations and small supplier businesses. The cluster also consists of related entities such as research universities and relevant programs, industry associations, community colleges, workforce training providers and other professional entities that support and develop firms and workers.
- 11 Note that a cluster should not be confused with a cluster or industry organization the cluster is defined by the economic interactions of its members, not their formal association (or not). Clusters may or may not form associations; and cluster organizations may or may not represent collections of firms that are genuinely "clustering" in the formal economic sense. See, Stuart Rosenfeld, "Industry Clusters: Business Choice, Policy Outcome, or Branding Strategy?" Journal of New Business Trends and Ideas 3(2) (November 2005): 5-6.
- 12 Individual firm attraction instead plays an important role as a tactic employed to implement strategies tailored to the assets and characteristics of the region e.g., targeting particular types of firms to fill out a strong local cluster. In these circumstances, the case that is made to attract the targeted firm is also different less focused on direct financial incentives (cost reduction) and more on adding value through infrastructure, human capital and other programs that improve the region for the entire industry and make the attracted firms "stickier" (less likely to leave for the next, lower-cost location).
- 13 Paul C Brophy, Robert Weissbourd, and Andy Beideman, *Transformative Economies: Emerging Practices for Aligning Growth and Inclusion*, Federal Reserve Bank of Philadelphia, October 2017.
- 14 For much more detailed literature review, see Weissbourd, Robert and Mark Muro, Metropolitan Business Plans: A New Approach to Economic Growth, Brookings Institution Metropolitan Policy Program: 2011; George Washington Institute of Public Policy and RW Ventures, LLC, Implementing Regionalism: Connecting Emerging Theory and Practice to Inform Economic Development, Online Publication: 2011, available at http://rw-ventures. com/wp-content/uploads/2017/01/Surdna-Final-Paper-Combined-112111.pdf; There are, of course, other equally good economic frameworks: this one has just proven particularly useful in translating economic theory to practice in the context of particular regional economies.
- 15 https://chicago.curbed.com/2019/7/9/20688097/water-chicago-meter-installation-lead-safety
- 16 https://www.mckinsey.com/industries/electric-power-and-natural-gas/our-insights/us-water-infrastructure-making-fundingcount?cid=other-eml-alt-mip-mck&hdpid=888a6136-80c7-42bf-8eb1-2cec4ed2a8c3&hctky=10006402&hlkid=79bb31aba7e140d7a744d727fb560b18
- 17 https://www.wqa.org/Whats-in-Your-Water/Emerging-Contaminants
- 18 https://www.niehs.nih.gov/health/topics/agents/pfc/index.cfm
- 19 https://www.researchandmarkets.com/reports/5574874/water-and-wastewater-treatment-market-by-type?utmsource=GNOM&utm medium=PressRelease&utmcode=4wrdzb&utmcampaign=1692171+-+Global+Water+and+Wastewater+Treatment+Market+Report+ to+2032+-+Growing+Demand+for+Energy-Efficient+and+Advanced+Water+Treatment+Technologies+Presents+Opportunities&utmexec=j amu273prd

- 20 https://www.researchandmarkets.com/reports/5574874/water-and-wastewater-treatment-market-by-type?utmsource=GNOM&utm medium=PressRelease&utmcode=4wrdzb&utmcampaign=1692171+-+Global+Water+and+Wastewater+Treatment+Market+Report+ to+2032+-+Growing+Demand+for+Energy-Efficient+and+Advanced+Water+Treatment+Technologies+Presents+Opportunities&utmexec=j amu273prd
- 21 https://www.researchandmarkets.com/reports/5574874/water-and-wastewater-treatment-market-by-type?utmsource=GNOM&utm medium=PressRelease&utmcode=4wrdzb&utmcampaign=1692171+-+Global+Water+and+Wastewater+Treatment+Market+Report+ to+2032+-+Growing+Demand+for+Energy-Efficient+and+Advanced+Water+Treatment+Technologies+Presents+Opportunities&utmexec=j amu273prd
- 22 https://www.researchandmarkets.com/reports/5574874/water-and-wastewater-treatment-market-by-type?utmsource=GNOM&utm medium=PressRelease&utmcode=4wrdzb&utmcampaign=1692171+-+Global+Water+and+Wastewater+Treatment+Market+Report+ to+2032+-+Growing+Demand+for+Energy-Efficient+and+Advanced+Water+Treatment+Technologies+Presents+Opportunities&utmexec=j amu273prd
- 23 https://static1.squarespace.com/static/54806478e4b0dc44e1698e88/t/56f2c9fa8a65e2120e70f62d/1458752003954/Beecher-WWOASpringBiosolidsSymposium-22Mar2016-lite.pdf; https://www.anl.gov/article/argonne-scientists-create-water-filtrationmembranes-that-can-clean-themselves; https://www.aquatechtrade.com/news/wastewater/water-trends-2020/#; https://www.mckinsey. com/industries/electric-power-and-natural-gas/our-insights/us-water-infrastructure-making-funding-count?cid=other-eml-alt-mipmck&hdpid=888a6136-80c7-42bf-8eb1-2cec4ed2a8c3&hctky=10006402&hlkid=79bb31aba7e140d7a744d727fb560b18; https://www. sciencedirect.com/science/article/pii/S0301479721000396; https://sanfrancisco.cbslocal.com/2021/05/11/california-drought-recycledwater-investment-paying-off-for-north-marin-water-district/
- 24 https://www.researchandmarkets.com/reports/5574874/water-and-wastewater-treatment-market-by-type?utmsource=GNOM&utm medium=PressRelease&utmcode=4wrdzb&utmcampaign=1692171+-+Global+Water+and+Wastewater+Treatment+Market+Report+ to+2032+-+Growing+Demand+for+Energy-Efficient+and+Advanced+Water+Treatment+Technologies+Presents+Opportunities&utmexec=j amu273prd
- 25 https://www.watertechonline.com/wastewater/article/14167403/treating-active-pharmaceutical-ingredients-in-manufacturingwastewater
- 26 https://www.prnewswire.com/news-releases/global-water-quality-monitoring-devices-market-to-reach-4-1-billion-by-2026--301322531. html#:~:text=Amid%20the%20COVID%2D19%20crisis,5%25%20over%20the%20analysis%20period
- 27 https://www.idtechex.com/en/research-report/sensors-in-the-water-and-wastewater-treatment-industries-2020-2030/737
- 28 https://www.maximizemarketresearch.com/market-report/global-water-quality-sensor-market/71798/
- 29 https://www.maximizemarketresearch.com/market-report/global-water-quality-sensor-market/71798/; https://www.businesswire.com/ news/home/20220119005768/en/Global-Water-Testing-Analysis-Market-Report-2022---Pandemic-Brings-to-Light-the-Demand-Supply-Gap-in-Accessing-Clean-and-Safe-Water---ResearchAndMarkets.com
- 30 https://www.businesswire.com/news/home/20220119005768/en/Global-Water-Testing-Analysis-Market-Report-2022---Pandemic-Bringsto-Light-the-Demand-Supply-Gap-in-Accessing-Clean-and-Safe-Water---ResearchAndMarkets.com
- 31 https://www.industryarc.com/Report/19128/pipes-and-fittings-market
- 32 https://www.nasdaq.com/articles/state-of-the-water-industry-2021-2021-10-04
- 33 https://www.bccresearch.com/market-research/environment/water-infrastructure-repair-technology-markets-report.html
- 34 https://www.freedoniagroup.com/industry-study/global-water-infrastructure-pumps-4372.htm
- 35 https://www.businesswire.com/news/home/20201019005639/en/Global-Pipes-and-Fittings-Market-2020-to-2025---Increased-Pipeline-Projects-is-Driving-Growth---ResearchAndMarkets.com
- 36 https://www.businesswire.com/news/home/20220329005600/en/The-Worldwide-Stainless-Steel-Plumbing-Pipes-Industry-is-Expectedto-Reach-4.9-Billion-by-2030---ResearchAndMarkets.com
- 37 American Water Works Association (AWWA) annual survey, https://www.awwa.org/AWWA-Articles/awwa-survey-infrastructurefinancing-remain-top-water-issues-emergency-preparedness-concerns-increasing
- 38 https://www.mckinsey.com/industries/electric-power-and-natural-gas/our-insights/us-water-infrastructure-making-funding-count
- 39 https://www.nasdaq.com/articles/state-of-the-water-industry-2021-2021-10-04
- 40 Note that this segment also includes water recycling systems, which overlaps with treatment technologies. https://dataintelo.com/report/global-water-saving-plumbing-product-market/
- 41 https://www.nature.com/articles/s41545-019-0039-9#:~:text=Global%20water%20demand%20has%20increased,over%20the%20 past%20100%20years.&text=This%20corresponds%20to%20an%20annual,this%20figure%20may%20be%20optimistic
- 42 https://www.theasset.com/article-esg/45699/water-as-an-asset-class-is-here
- 43 https://www.unwater.org/publications/progress-on-water-use-efficiency-641-2021-update/
- 44 https://www.idrica.com/wp-content/uploads/2021/02/Idrica-Global-Water-Trends-2021-EN.pdf; https://www2.deloitte.com/content/dam/ Deloitte/pl/Documents/Reports/plWater-Tight-2-0-The-top-trends-in-the-global-water-sector.pdf; Challenges to data integration is that data is often collected in different formats that are not compatible with each other and there are many instances of data duplication. Data may also be siloed in different departments within the same facility or facilities may be reluctant to share data outside of the facility.

- 45 https://www.businesswire.com/news/home/20211214006076/en/Global-Water-and-Wastewater-Treatment-Outlook-Report-2022-Leveraging-Al-based-Data-Analytics-Platforms-for-Achieving-Decarbonization-of-Water-and-Wastewater-Treatment-Infrastructure---ResearchAndMarkets.com
- 46 https://waterinthewest.stanford.edu/news-events/news-insights/building-effective-water-data-platforms
- 47 A 2019 PWC report identifies the water sector as one of the industries where AI is likely to have a significant economic impact; https://www. digitalpulse.pwc.com.au/report-ai-earth-sustainable-future/
- 48 https://h2oglobalnews.com/expert-insights-accelerating-tech-adoption-in-the-water-sector/
- 49 https://www.freshlawblog.com/2022/02/22/the-trend-toward-heightened-cybersecurity-for-the-water-utility-sector/
- 50 https://www.energy.gov/articles/ensuring-resiliency-our-future-water-and-energy-systems
- 51 https://www.energy.gov/sites/default/files/2014/07/f17/Water%20Energy%20Nexus%20Full%20Report%20July%202014.pdf
- 52 https://www.iea.org/articles/introduction-to-the-water-energy-nexus
- 53 https://www.researchandmarkets.com/reports/5574874/water-and-wastewater-treatment-market-by-type?utmsource=GNOM&utm medium=PressRelease&utmcode=4wrdzb&utmcampaign=1692171+-+Global+Water+and+Wastewater+Treatment+Market+Report+ to+2032+-+Growing+Demand+for+Energy-Efficient+and+Advanced+Water+Treatment+Technologies+Presents+Opportunities&utmexec=j amu273prd
- 54 https://www.waterrf.org/sites/default/files/file/2022-09/4949-Resource-Recovery.pdf
- 55 https://www.cambridge.org/core/journals/mrs-energy-and-sustainability/article/from-waste-treatment-to-resource-recovery-a-chicagosustainability-story/B3A8A2350FE8172EBCE1FDCC636397C9
- 56 https://www.waterworld.com/wastewater/article/16193701/recovering-resources-nitrogen-and-phosphorus-recovery-integral-tonutrient-management-vision
- 57 https://www.researchandmarkets.com/reports/5574874/water-and-wastewater-treatment-market-by-type?utmsource=GNOM&utm medium=PressRelease&utmcode=4wrdzb&utmcampaign=1692171+-+Global+Water+and+Wastewater+Treatment+Market+Report+ to+2032+-+Growing+Demand+for+Energy-Efficient+and+Advanced+Water+Treatment+Technologies+Presents+Opportunities&utmexec=j amu273prd
- 58 https://mwrd.org/resource-recovery
- 59 https://www.cambridge.org/core/journals/mrs-energy-and-sustainability/article/from-waste-treatment-to-resource-recovery-a-chicagosustainability-story/B3A8A2350FE8172EBCE1FDCC636397C9
- 60 Water Cluster Initial Research 2020
- 61 https://www.istcoalition.org/data/index/2022-rd-index-report/
- 62 https://ssti.org/blog/useful-stats-business-rd-expenditures-state-and-source-funding-2019
- 63 Non-Federal sources can include funds from academia and nonprofit organizations.
- 64 https://www.istcoalition.org/data/index/2022-rd-index-report/
- 65 Crunchbase, 2021
- 66 Patent data from USPTO (2010-2021)
- 67 The patent search on USPTO was conducted using keywords in the patent documents filed by inventors and their associated companies. It is likely that this broad search has pulled in non-water technology patents as well. The figures generated by this analysis should be used only to assess the state's level of patent activity in specific application and technology areas relative to other states.
- 68 Defined according to Crunchbase categories: Natural Resources (Water), Sustainability (Natural Resources, Waste Management, Water Purification) and Transportation (Water Transportation)
- 69 https://h2oglobalnews.com/expert-insights-accelerating-tech-adoption-in-the-water-sector/
- 70 CEO of the Massachusetts Clean Energy Center
- 71 https://www.mckinsey.com/industries/electric-power-and-natural-gas/our-insights/us-water-infrastructure-making-fundingcount?cid=other-eml-alt-mip-mck&hdpid=888a6136-80c7-42bf-8eb1-2cec4ed2a8c3&hctky=10006402&hlkid=79bb31aba7e140d7a744d727fb560b18
- 72 Marianne Bertrand, A. W. (2022). Equal Opportunity in Chicago's Construction Occupations. Chicago: Inclusive Economy Lab.
- 73 DataUSA, 2022
- 74 MKM Consultants
- 75 https://www.brookings.edu/research/rethinking-cluster-initiatives/

#### 76 https://www.resilienceinnovationhub.com/

77 People of color are more likely to have been or be currently employed in legacy industries that have experienced the most disruption in the new economy. This has driven greater under- and unemployment among these workers, and places them disproportionately in industries that are less likely to be employing sophisticated hiring practices. These workers also face more barriers to connecting with employment and training opportunities. Companies increasingly rely on online networks, such as LinkedIn, to source employees, and these networks have lower representation of people of

color. In addition, people of color are less likely to hold academic credentials that employers tend to over-rely on. Disconnected populations regularly face challenges in accessing education and training opportunities, be it due to costs, physical proximity, finding childcare, etc.

- 78 Advisory Group meeting suggestion
- 79 MKM Consultants
- 80 A technical and financial feasibility study of three potential water-technology demonstration centers around the state of Massachusetts.
- 81 https://www.ornl.gov/facility/btric
- 82 https://bit.ly/3rk0vYS
- 83 https://www.southlanddevelopment.org/mid-sized-small-business-owners/
- 84 https://www.southlanddevelopment.org/mme/
- 85 https://www.mxdusa.org/cyber/
- 86 https://thewatercouncil.com/programs/
- 87 In 2014, Michigan's University Research Corridor (comprising Michigan State University, University of Michigan, and Wayne State University) commissioned a report from the Anderson Economic Group, LLC to research Michigan's water cluster and assess the role of the universities in water-related research and innovation.
- 88 https://www.urcmich.org/partners/in-water
- 89 https://news.umich.edu/michigan-s-university-research-corridor-plays-major-role-in-protecting-and-advancing-michigan-s-blueeconomy/
- 90 The study was performed in 2013. The GOED classified industries as low, medium, or high priority. The highest-ranked industries were those working on water efficiency and innovation. Nevada is one of the few regions that has already published a future-oriented plan for their regional water cluster for the post-pandemic context.
- 91 A statewide water technology initiative that was founded by civic and industry leaders in 2015 after a major drought in the region
- 92 Established in 2011 and leads the Central Valley Regional Innovation Cluster
- 93 https://clevelandwateralliance.org/
- 94 https://www.tmabluetech.org/
- 95 https://www.theh2otower.org/
- 96 https://www.masscec.com/water-innovation
- 97 https://sea-ahead.com/
- 98 https://www.glc.org/news/be-092721
- 99 https://www.glc.org/
- 100 https://www.glc.org/work/blue-economy
- 101 https://www.brookings.edu/wp-content/uploads/2019/02/2019MetroGCIGlobal-Trade-PlanSyracuse.pdf
- 102 https://cdn.orbusinesscouncil.org/docs/policy/1aaREVISED2022-OBCWaterReport.pdf
- 103 https://www.export.gov.il/en/%20Water
- 104 https://startupnationcentral.org/sector/watertech/#:~:text=Israeli%20Watertech%20is%20spearheading%20the,water%20 reclamation%3B%20smart%20irrigation%20for
- 105 https://blogs.worldbank.org/water/israel-how-meeting-water-challenges-spurred-dynamic-export-industry#:~:text=Water%20has%20 become%20a%20US,companies%20and%20over%20100%20startups
- 106 https://blogs.worldbank.org/water/israel-how-meeting-water-challenges-spurred-dynamic-export-industry#:~:text=Water%20has%20 become%20a%20US,companies%20and%20over%20100%20startups
- 107 https://www.pub.gov.sg/watersupply/singaporewaterstory
- 108 https://www.netherlandswaterpartnership.com/
- 109 https://www.h2nowchicago.org/
- 110 http://uswateralliance.org/sites/uswateralliance.org/files/publications/uswalistenbig7032618a.pdf
- 111 https://news.wttw.com/2021/12/16/biden-calls-chicago-s-lead-pipes-be-removed-within-10-years-slow-roll-out-continues
- 112 https://www.leadsafechicago.org/lead-service-line-replacement; https://blogs.edf.org/health/2019/09/25/llinois-lead-service-line-inventory-chicago-small-systems/
- 113 https://www.energyefficiencyforall.org/resources/increasing-water-efficiency-and-reducing-cost-in-affordable-housing-a-case/
- 114 Brophy, Paul, Weissbourd, Robert, and Andy Beideman, *Transformative Economies: Emerging Practices for Aligning Growth and Inclusion*, Federal Reserve Bank of Philadelphia: 2017.

- **115** Evidence is emerging that there may be limits to the benefits of concentration in large metropolitan areas. As negative amenities like high housing costs and congestion emerge, more people and firms are moving to "second tier" metropolitan areas. (See Strategies section for more on the "right-sized cities" phenomenon).
- 116 Deliberate, tailored strategies are particularly important in the knowledge economy because the growth trajectories of regional economies are diverging. In the past, underperforming regions tended to "catch up" with their higher-performing peers over time. In the new economy, this dynamic has changed. As knowledge assets such as human capital, information technologies and information sector firms increasingly concentrate, they build upon themselves and generate increasing rather than diminishing returns. This drives a self-reinforcing growth cycle, and as a result, high-performing regions now tend to pull further ahead of their competitors. See generally: Joseph Cortright, "New Growth Theory, Technology and Learning: A Practitioner's Guide," Reviews of Economic Development Literature and Practice, 4: 2001; Weissbourd, Robert and Christopher Berry, *The Changing Dynamics of Urban America*, Online Publication: 2004.
- 117 Individual firm attraction instead plays an important role as a tactic employed to implement strategies tailored to the assets and characteristics of the region e.g., targeting particular types of firms to fill out a strong local cluster. In these circumstances, the case that is made to attract the targeted firm is also different less focused on direct financial incentives (cost reduction) and more on adding value through infrastructure, human capital and other programs that improve the region for the entire industry and make the attracted firms "stickier" (less likely to leave for the next, lower-cost location).
- 118 For more information on quality growth, see materials at https://newgrowth.org/, describing The New Growth Innovation Network, a new national organization that brings together economic development leaders committed to building a new field of quality economic growth practice.
- 119 Pastor, Manuel and Chris Benner, Equity, Growth, and Community: What the Nation Can Learn from America's Metro Areas, University of California Press: 2015, available at https://doi.org/10.1525/luminos.6; Weissbourd and Berry, The Changing Dynamics of Urban America; Ostry, Jonathan D., Berg, Andrew and Charalambos G. Tsangarides, "Redistribution, Inequality, and Growth," IMF Staff Discussion Note: April 2014, available at www.imf.org/external/pubs/ft/sdn/2014/sdn1402.pdf; OECD Directorate for Employment, Labour, and Social Affairs, "Does Inequality Hurt Economic Growth?" Focus on Inequality and Growth, 9: 2014; OECD, In It Together: Why Less Inequality Benefits All, Online Publication: 2015, available at www.oecd.org/social/in-it-together-why-less-inequality-benefits-all-9789264235120-en.htm.
- 120 Pastor and Benner, Equity, Growth, and Community: What the Nation Can Learn from America's Metro Areas.
- 121 Brophy et al., Transformative Economies: Emerging Practices for Aligning Growth and Inclusion.
- 122 For much more detailed literature review, see Weissbourd, Robert and Mark Muro, Metropolitan Business Plans: A New Approach to Economic Growth, Brookings Institution Metropolitan Policy Program: 2011; George Washington Institute of Public Policy and RW Ventures, LLC, Implementing Regionalism: Connecting Emerging Theory and Practice to Inform Economic Development, Online Publication: 2011, available at http://rw-ventures.com/wp-content/uploads/2017/01/Surdna-Final-Paper-Combined-112111.pdf; There are, of course, other equally good economic frameworks: this one has just proven particularly useful in translating economic theory to practice in the context of particular regional economies.

