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## Rising Service Costs and Climate Change: Why Demand-Side Management is Necessary within Water Planning

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### Introduction

As the Great Lakes region comes to terms with navigating the water and wastewater infrastructure replacement era, there has been growing interest in influencing demand and properly managing existing infrastructure. The management of urban water and wastewater has historically been addressed with development of supply side capacity sufficient to meet future needs. Use of demand-side management (DSM) in water management is increasing globally, and the Great Lakes region is no exception. There is increasing recognition that decisions based on the notion of water needs belies the fact that demand is influenced by an array of factors – and so, we start to question whether continuing to build out supply to meet needs is the best answer. There is increasing recognition that 100-year flood events are occurring more and more frequently, and the importance of proactively and cost-effectively addressing potential asset failures to manage increased risks is becoming more and more apparent. This issue brief makes a case for employing demand-side management strategies and increased system efficiency within water and wastewater utilities in the Great Lakes to address management of aging infrastructure and climate risk. The benefits of several policies are discussed, including full cost pricing, asset management, quantity rationing, public information and outreach, and alternate supply side strategies.

### Great Lakes Regional Context

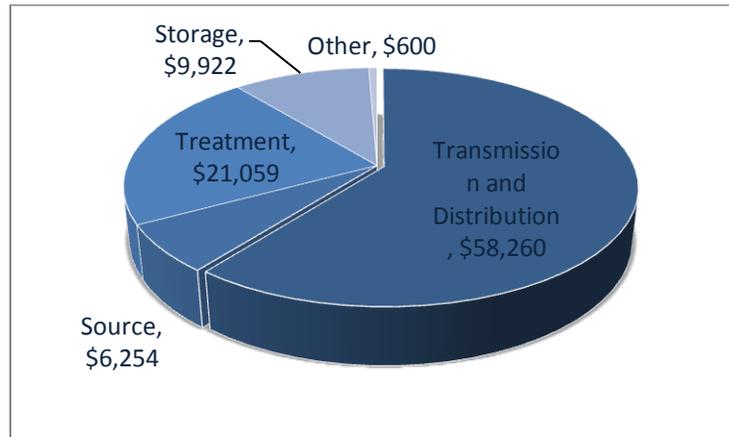
The Great Lakes region of the United States includes the eight [states](#) of [Illinois](#), [Indiana](#), [Michigan](#), [Minnesota](#), [New York](#), [Ohio](#), [Pennsylvania](#), and [Wisconsin](#). The Great Lakes are unique for numerous reasons, not the least of which is that they are the largest, most abundant source of freshwater on earth. As such, the region is uniquely positioned to set an example for freshwater stewardship, while addressing future costs of water and wastewater supply, economic growth, and increasing system risks.

- **Rising Costs** Rising water and wastewater service costs are largely attributed to the need for infrastructure repair and replacement. According to the U.S. Environmental Protection Agency, water and wastewater utilities in the U.S. are facing a funding shortfall of hundreds of billions of dollars by 2020 due to insufficient capital investment, amounting to \$96 billion estimated necessary investment drinking water infrastructure in the Great Lakes region alone (see Figure 1).<sup>1</sup> Great Lakes cities are estimated to have an additional need for \$23.3 billion wastewater infrastructure.<sup>2</sup>

<sup>1</sup> [www.epa.gov/owm/gapreport.pdf](http://www.epa.gov/owm/gapreport.pdf)

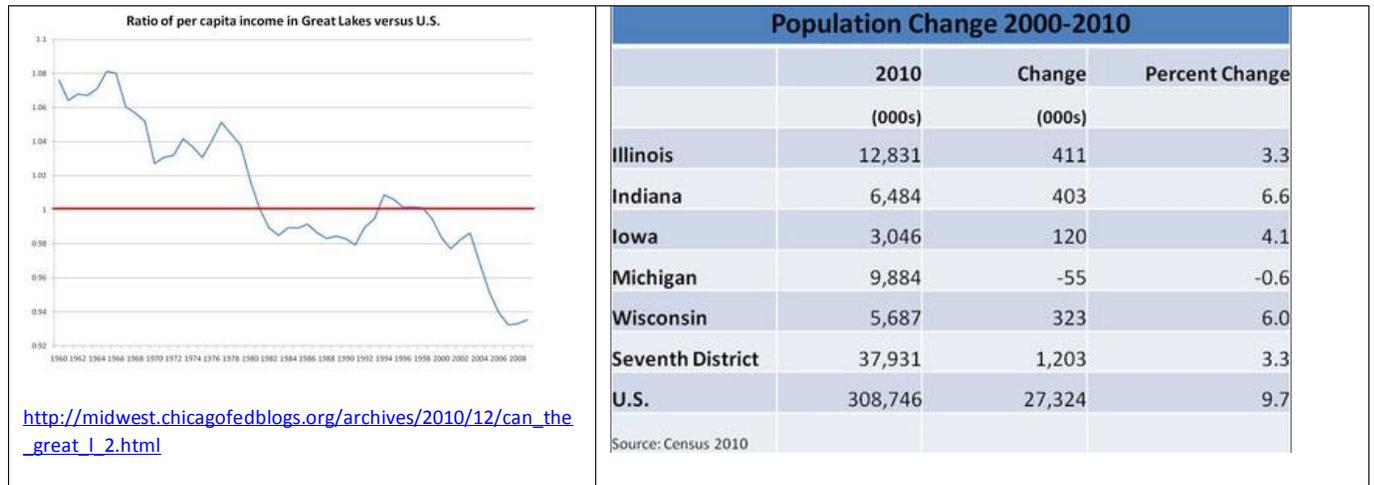
<sup>2</sup> 2008 Clean Watersheds Needs Survey, U.S. EPA, p 50

Figure 1. \$96 Billion Great Lakes Drinking Water Infrastructure Need 2007 – 2027 (U.S. EPA, 2009)



- Economy** The water assets of the Great Lakes historically contributed to the strength of the Great Lakes regions' economy. In the current economic downturn, the Great Lakes region has struggled disproportionately more than the nation as a whole. This greater susceptibility to economic downturns is evident in the decline of Great Lakes per capita income relative to the U.S. [Figure 2]. The population growth rate in the Great Lakes region lags behind that of the nation as a whole.<sup>3</sup> Proper management of Great Lakes water assets ensures continued economic development opportunities.

Figure 2: Great Lakes Region Economy



- Climate Risk** There is general agreement across the best climate models that the Great Lakes region is expected to experience increased heat waves, increased evapotranspiration, and reductions in overall precipitation but increases in extreme precipitation events. As evapotranspiration exceeds precipitation, Great Lakes levels are expected to decrease, as is available groundwater, resulting in possible declines in water quality from higher concentrations of nutrients and pollutants.<sup>4</sup> Expected impacts on systems include:

<sup>3</sup> [http://midwest.chicagofedblogs.org/archives/2010/12/can\\_the\\_great\\_l\\_2.html](http://midwest.chicagofedblogs.org/archives/2010/12/can_the_great_l_2.html)

<sup>4</sup> See U.S. Global Change Research Program. (2009). *Global Climate Change Impacts in the United States*. Thomas R. Karl, Jerry M. Melillo, and Thomas C. Peterson, (eds.). Cambridge University Press; U.S. Climate Change Science Program (2008). *Weather and Climate Extremes in a Changing Climate – Synthesis and Assessment Product 3.3*.

increased water demand, increased drought, flooding, and inundation risk, declining source quality, and increased regulation. While there are many adaptation strategies to address these impacts, developing and implementing these adaptation strategies will increase costs. One estimate of the costs of such adaptation strategies in the United States is \$448 to \$944 billion through 2050.<sup>5</sup> There is evidence that municipal bonds, the most commonly used means of financing infrastructure improvements, fail to adequately capture water scarcity risks in their ratings.<sup>6</sup>

## Understanding Efficiency Improvements

In the past, infrastructure investment has been undertaken based on forecasted water needs, without consideration of demand side factors, resulting in both inefficient infrastructure investment and inefficient pricing. Movement toward more efficient systems is possible, but requires consideration of demand side behavior and information into decision making, in order to weigh the benefits of investment against the costs.

- **Demand Side Management** – Investments in demand side management can delay, downsize, or indefinitely defer infrastructure investment. When demand growth can be reduced, the timing of infrastructure investments is affected, resulting in savings when building sooner and larger would have been more costly. When savings costs resulting from altered investment timing are greater than costs of planning and implementing the demand side management program, undertaking the demand side program is beneficial.<sup>7</sup> To be considered efficiency-improving, demand-side management must therefore increase net benefits (to consumers, producers, government)<sup>8</sup>

## Benefits of Demand-side Management

- Delayed, deferred and/or downsized infrastructure investment costs
  - Energy Savings
  - Operation and maintenance costs
  - Wastewater reduction
  - Enhanced reputation and customer relations
  - Adaptation to increased weather risk
  - Increased flow of environmental and ecosystem services
  - Avoided shortages
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- **Asset management** Well-timed investment in the repair, refurbishing, and replacement of infrastructure assets can help utilities provide the greatest level of service (benefit) for the least possible cost. Asset management, like demand side management, proposes that premature infrastructure investment can be costly, and that system efficiency can be increased by more carefully deploying asset management strategies, and by considering non-asset management strategies (such as demand-side management) alongside infrastructure strategies. Using information on the source, probability and consequences of asset failure, employing asset management can help utilities achieve cost efficiency. Consideration of demand-side strategies can be incorporated into the asset management analysis framework to evaluate comparative cost efficiencies relative to asset investment strategies.

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<sup>5</sup> Source: Confronting Climate Change : An Early Analysis of Water and Wastewater Infrastructure Costs Association of Metropolitan Water Agencies October 2009.

<sup>6</sup>A report by Ceres and Water Asset Management finds that investment in water infrastructure as guided by municipal bond market ratings fails to consider growing water scarcity risks occurring from factors such as climatic change. <http://www.ceres.org/Document.Doc?id=625>.

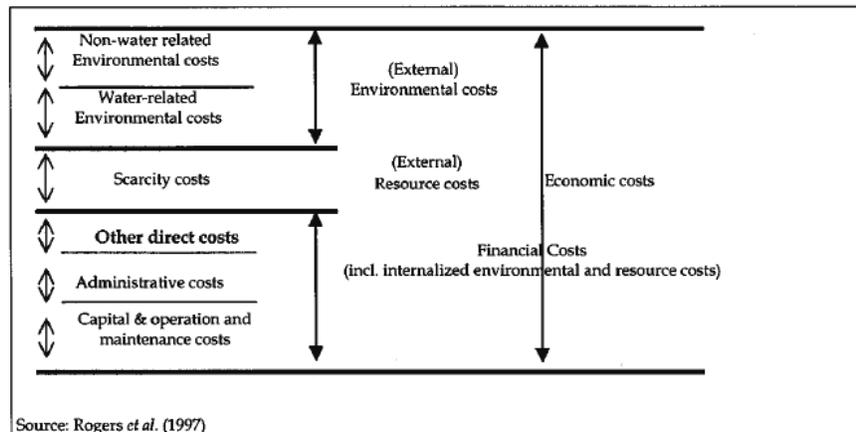
<sup>7</sup> For example, every dollar invested in regional water supply planning, including investment in demand side management, generates 2.0 in benefits to the planning region, in terms of avoided supply development costs (Schneemann, M. 2008. Presentation to the Northeastern Illinois Regional Water Supply Planning Group titled, "Economic Value of Regional Water Supply Planning."). The Alliance for Water Efficiency additionally estimates benefits from investing in water efficiency are 2.5 – 2.8 on the dollar, so that for every 1 million invested in water efficiency, total economic output increases by \$2.5 million to \$2.8 million (Alliance for Water Efficiency and American Rivers, "Creating Jobs and Stimulating the Economy through Investment in Green Water Infrastructure" (2008)).

<sup>8</sup> Net benefit is equal to total benefits minus total costs. Net benefits will actually be the sum of the discounted stream of benefits and costs over the planning horizon.

## Policy Benefits: Examples

As a practical matter, evaluation of the net benefits of demand-side policies requires information on local service area factors that influence demand, including socioeconomic characteristics, climate, housing characteristics, and current policies. These factors vary significantly across Great Lakes communities and will therefore significantly influence policy impacts. It is recommended that Great Lakes utilities estimate their demand based on local data, just as they would form their asset management strategies based on their own local assets and local asset conditions. Since demand estimation can be data and time intensive, this discussion is limited to the direction and likely magnitude of policy impacts.

Beyond customer and utility financial impacts, there are economic impacts resulting from a widening of the accounting stance to include impacts on resources and the environment. Since financial costs are more readily available than economic costs, they typically form the basis of a policy impact analysis. Economic costs must be estimated using economic valuation methods such as hedonic pricing, averting behavior, recreation demand models, and contingent valuation and contingent ranking. As these methods are data and knowledge intensive they have not been incorporated as a rule into policy analysis at the utility level.



Source: Rogers *et al.* (1997)

- 1. Price increase** Increasing prices to a more economically efficient level encourages water customers to become more efficient in their water use, and promotes adoption of system efficiency improvements by utilities. Historically low prices have promoted inefficient use of water and led to inefficient capacity expansion decisions. Increased prices translate into a reduction in the quantity demanded and sold, revenue increases,<sup>9</sup> and decreased production costs. The net impact, considering financial costs, depends on the value of lowered utility production costs. When economic costs are considered, the net benefit will also be impacted by saved scarcity and resource costs resulting from reductions in water use.
- 2. Quantity Rationing** Limiting the amount of outdoor water use, such as alternate day restrictions, is pervasive across the Great Lakes Region. The net impact of quantity rationing is the same as price increases above, with the change that the reduction in water use is required to come from a specific use (outdoor use) rather than at the customers' discretion so that water use reductions may not be allocated efficiently. Quantity rationing results in a revenue decrease, whereas price increases caused revenue to increase. Price increases therefore result in higher benefits to society than quantity rationing, albeit restrictions remain popular with the public.

<sup>9</sup> Total revenue is equal to price times quantity. A price increase means that quantity goes down, but the price paid on sold units is greater. The net effect is to increase revenue, since demand for water is inelastic.

When economic costs are considered, the increased compliance enforcement costs act to offset saved scarcity and resource costs.

3. **Public Information and Outreach** Solidly designed and implemented demand side programs, such as a public information campaign coupled with outreach promotion of water efficient devices, may allow consumers to get the same water value from consumption while using less water. Consumers save on water bills, and production costs decrease. The benefits will be net costs of the program development and implementation, and the economic costs will include scarcity and resource cost savings. When expensive capacity development can be delayed, such demand-shifting policy can have large net benefits.
4. **Supply-side Efficiency Improvements** Increasing system efficiency, for example through leak detection programs, can result in deferral or delay of capacity expansion. Obtaining less expensive supply shifts supply downward, thereby lowering costs. Consumer benefits are increased by a lower of costs. Economic net benefits will need to consider any negative environmental impacts (for example reduced ancillary infiltration, groundwater recharge from leaks) against any positive impacts (reduced withdrawals).

As the above examples illustrate, implementing and evaluating the demand side management and efficiency improvements clearly requires careful thought, communication across many levels of expertise within the utility organization, and coordination with outside partners such as consultants and technical assistance providers. Just as clearly, failure to address increasing risks from infrastructure aging and increasing weather variability bears a cost that many communities will be unable, or are unwilling, to bear.