AT&T 10x Case Study:

Lowe's Uses HydroPoint and AT&T to Reduce Water Consumption and Carbon Footprint

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AT&T believes technology plays a critical role in reducing carbon emissions, so we're using the power of our network to create a better, more environmentally sustainable world. We've set a 10x carbon reduction goal to enable carbon savings 10x the footprint of our operations by the end of 2025.

To meet this goal, we're working companywide to make our operations more efficient. We're also working with our customers and technology partners to implement and scale carbon-saving solutions. This case study discusses and quantifies the carbon benefits of using AT&T technology to boost efficiency. This is one study in a series we're sharing as we progress toward our 10x goal.

For more information about our goals, our progress, and to view more case studies like this, go to AT&T's 10x website.

Summary:

Lowe's is focused on reducing its environmental impact while also increasing efficiency of its operations. To address these areas, Lowe's has installed HydroPoint® smart irrigation controllers that use AT&T Internet of Things (IoT) to optimize landscape irrigation outside 939 of its stores. Each year, the controllers reduce water use at these facilities by about 650 million gallons, saving Lowe's an estimated $5 million in total water costs.[1] Because water treatment and pumping uses so much energy, saving 650 million gallons of water also effectively reduces community greenhouse gas (GHG) emissions by an amount equal to burning 84 thousand gallons of gasoline.

Annual Savings using HydroPoint at 939 Lowe's stores:

$5 million

650 million gallons

84 thousand gallons of gasoline (GHG equivalent)

1 Water-related cost savings estimated using average cost of .00776/gallon

The Challenge: Reduce retail store environmental footprint and operational costs.

Lowe's opened its first hardware store in North Carolina in 1946. It's now a Fortune® 50 home improvement company with thousands of home improvement and hardware stores in the United States, Canada and Mexico. In 2017, Lowe's employees helped over 18 million customers a week find the right equipment and materials for their projects.[2]

As experts in home improvement, including lawn and garden care, Lowe's understands the environmental impact of landscape irrigation. It also recognizes that being more efficient in its irrigation can lead to cost reductions. Lowe's is focused on projects that drive cost and environmental benefits, especially GHG emission and water use.

Lowe's recognized highly efficient landscape irrigation would address those goals effectively. Not only does efficient irrigation optimize water use, but it also has a hidden GHG benefit because most water is cleaned and pumped before it is used, a process that can be energy intensive. As a result, reducing water usage by using a more efficient irrigation system also reduces energy and associated GHG emissions.

> **"In 2014, we worked with our sustainability team to identify smart investments that would increase our efficiency while also reducing our environmental impact."**
>
> **– Jay Clement, Lowe's director of facilities**

up to ***half*** **of water used for irrigation is wasted**

The EPA WaterSense program estimates that as much as 50 percent of water used for irrigation is wasted because of evaporation, wind or runoff caused by inefficient irrigation methods and systems.[3] Recognizing this, Lowe's evaluated several options before making its decision to invest in efficient landscape irrigation.

2 Lowe's 2017 Social Responsibility Report

3 https://www.epa.gov/sites/production/files/2017-03/documents/ws-factsheet-outdoor-water-use-in-the-us.pdf

The Solution: HydroPoint and AT&T IoT use data to drive efficiency.

HydroPoint stood out as a premier solution based on the results of more than 25 public and private studies.[4] HydroPoint uses AT&T Internet of Things (IoT) technology that couples the reliable and secure AT&T network with SIM technology and the AT&T Control Center, an automated connectivity management platform that helps deploy and manage connected devices. In business since 2002, HydroPoint solutions have proven to achieve 95 percent[5] of conservation potential while reducing water use between 16 percent and 59 percent. They accomplish these results by leveraging detailed weather data transmitted using AT&T IoT connectivity to identify the optimal time and amount of water needed for irrigation, while keeping landscapes and plants healthy.

Each day, the HydroPoint Climate Center analyzes over 8 million weather data points from around the world, including over 50,000 U.S. weather stations and hundreds of thousands of other data sources, from aircraft to radio buoys and weather sensors (see Figure 1). This data is used to develop a model that calculates temperature, wind, humidity and solar radiation for every square kilometer of the continental U.S. and every 100 meters for Hawaii.

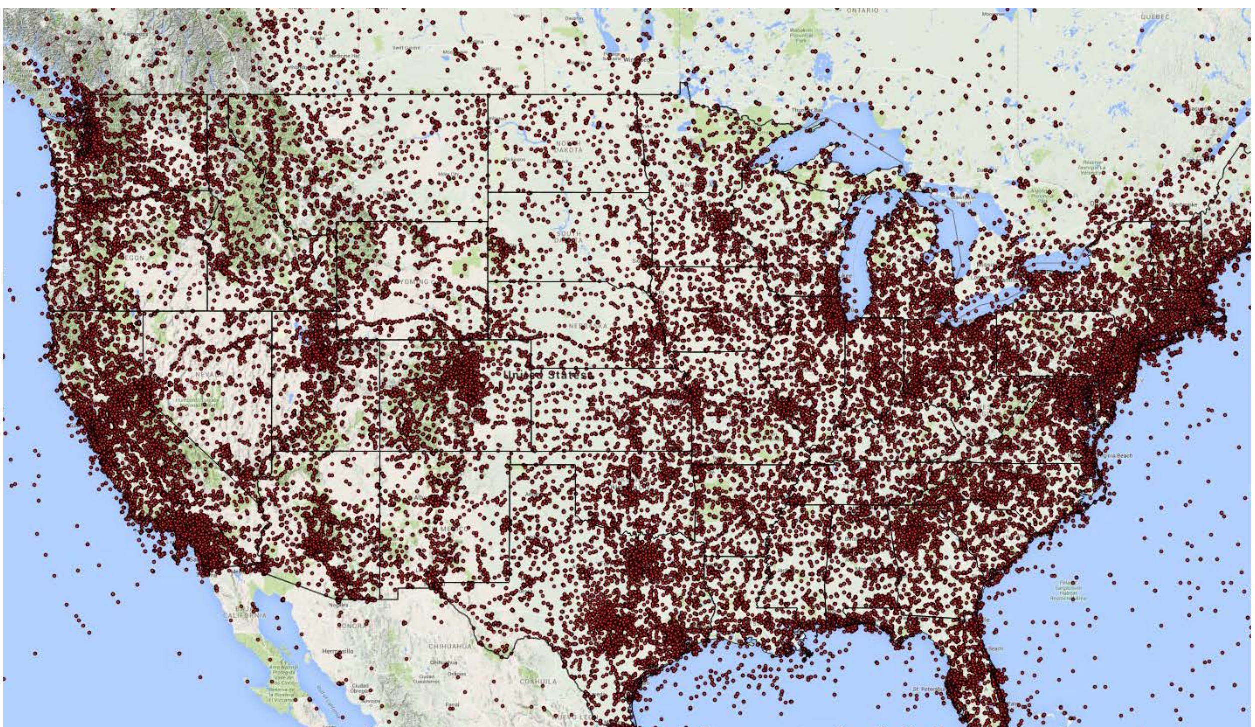


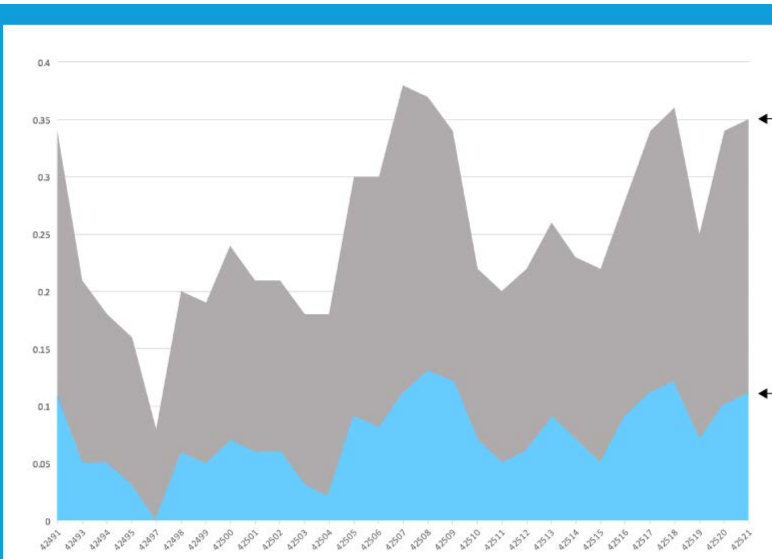
Figure 1

This analysis provides the system with superior weather data, specifically evapotranspiration (ET). A combination of four weather parameters – temperature, wind, solar radiation and humidity – ET is a highly accurate way to calculate landscape water needs and the primary indicator that HydroPoint uses to control irrigation.

4 https://www.HydroPoint.com/resources/research-studies/

5 Ibid

Unfortunately, many irrigation controllers only use temperature to determine irrigation patterns, which can overwater the landscape by as much as 43 percent (see Figure 2).[6] Using AT&T IoT connectivity to collect and distribute rich ET data, HydroPoint can analyze more complete weather data and communicate with irrigation controllers to use water in a very efficient manner. Plus, it provides timely information to system managers.



ASCE ET (4 Parameters) vs. Temp only ET (1 Parameter) May 2016 at CIMIS Station #83 (Santa Rosa)

ET calculated only using temperature.

What you lose every day in potential savings.

WeatherTRAK's ET calculated using temperature, wind, solar radiation & humidity.

Figure 2

Implementation: Lowe's utilizes HydroPoint and AT&T to reduce building operation costs, water consumption and emissions.

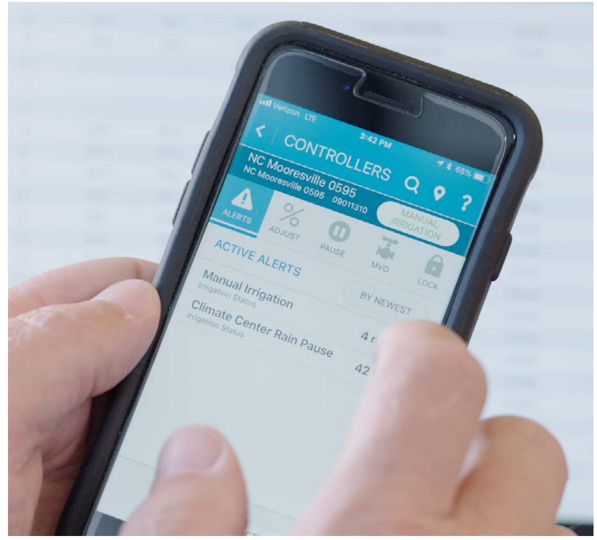
Lowe's pilot of HydroPoint began in 2008 and quickly grew to a few hundred stores by the end of 2010. Lowe's realized the robust savings it could generate with the system and have since expanded the program to **939 retail facilities.** The results of the program are impressive for the environment and the bottom line. Annual water bills are lower by an estimated **$5 million** and the associated annual water savings have swelled to about **650 million gallons**. And because most Lowe's stores use water from their local municipality, the company created annual downstream **GHG savings of about 750 metric tons CO_2e,** which is comparable to avoiding the use of over **84,000 gallons of gasoline.**[7]

> "This is an example of a project that provides multiple layers of benefits. By expanding our use of HydroPoint, we save money while reducing water usage and greenhouse gas emissions in our community."
>
> – Colleen Penhall, Lowe's vice president of corporate social responsibility

6 Allen, Rick G. The ASCE Standardized Reference Evapotranspiration Equation. American Society of Civil Engineers, 2005. Table F-2: Statistical summary of the comparisons between various reference ET methods, using growing-season results from 82 site-years of daily and 76 site-years of hourly data.

7 EPA GHG Equivalencies Calculator - https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

Sustainability Impact: Recognizing the HydroPoint solution's impact, AT&T has expanded the relationship beyond IoT connectivity.



Through a collaboration with HydroPoint, AT&T now offers AT&T Smart Irrigation as a part of its Smart Cities suite of solutions available to AT&T Business customers. AT&T has also installed the Smart Irrigation solution at many of its facilities and achieved millions of gallons of water savings in its own operations. Together, AT&T and HydroPoint hope to stimulate the adoption of this effective and easy solution that can help customers save money while reducing water usage and associated carbon emissions.

The motivation is clear: wide adoption of this smart irrigation solution could have substantial environmental benefits. If 2,000 retail stores with irrigation needs similar to Lowes (e.g. 20 stores like Lowe's in the largest 100 U.S. cities) used HydroPoint or AT&T Smart Irrigation to increase the efficiency of their landscape irrigation, water use could be reduced by almost **1.4 billion gallons** and GHG emissions **1,590 metric tons.** This is equivalent to:

Water Savings

Almost 80 million US citizens skipping showers[8] (All of Los Angeles doesn't shower for 20 days!)

Carbon Emissions Reduction

Not burning 179,000 gallons of gasoline[9]

Combining HydroPoint Irrigation with AT&T Connectivity Has the Potential to:

1. **Create an effective and easy-to-use smart irrigation system that leverages comprehensive weather data to reduce water usage and costs; and**
2. **Reduce the GHG emissions associated with the cleaning and pumping of water used in our communities.**

8 https://www.home-water-works.org/indoor-use/showers 1.362 billion gallons/17.2 gallons per shower = 79.2 million showers

9 EPA Greenhouse Gas Equivalencies Calculator. https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

Applying the 10x Carbon Impact Methodology

Carbon Trust and BSR collaborated with AT&T in the development of a methodology to measure the carbon benefits of AT&T's technology. Details of the methodology can be found on the AT&T 10x website. The table below summarizes how the 10x methodology was applied to estimate the environmental impacts described in this case study.

Description of the Enabling Technology	AT&T connectivity enables real-time, 24/7 leak notification and communication of more complete weather data to irrigation controllers. This lets customers track and manage their water usage with greater speed, precision and simplicity using cloud-based water management systems.
Impact Category	This case study focuses on water savings resulting from the implementation of the HydroPoint cloud-based water management system that utilizes AT&T Internet of Things connectivity and the greenhouse gas (GHG) impact associated with these savings.
Materiality	The impact of installing HydroPoint cloud-based water management systems to monitor irrigated land results in reductions in water usage and GHG emissions. The GHG emissions savings arise from energy reductions in the processing and pumping of the water.
Attribution of Impacts	The water and carbon savings described in this case study are a result of the design and manufacture of the HydroPoint smart irrigation controller, combined with the use of AT&T's IoT technology. Both AT&T and HydroPoint are fundamental in enabling the environmental benefits of the HydroPoint smart irrigation controller.
Relationship to Systems	Many irrigation management systems solely use temperature to determine irrigation patterns. Using AT&T IoT connectivity, HydroPoint can analyze more complete weather data and communicate this data to irrigation controllers. This enables them to use water in a more efficient manner. AT&T connectivity also empowers the provision of granular and timely information to system managers. Increased visibility of water usage can boost potential to drive greater efficiency. The financial and environmental benefits arising from superior water savings enabled by AT&T connectivity, coupled with the ease of implementation, could encourage widespread adoption of smart water management systems, thus delivering scalable environmental benefits.
Enabling and Rebound Effects	
Primary Effects	The implementation of HydroPoint technology delivers significant water savings. It also avoids the energy usage associated with processing and pumping wasted water. GHG savings follow energy savings and are dependent on the electricity grid mix in the state of interest. There are also direct cost savings associated with reducing water consumption.

Secondary Effects	Depending on the size of a site, installing smart water management technology may reduce emissions from site vehicles as the automation removes the need to physically visit control valves and controllers within the irrigation system. This was not included in the study.
Rebound Effects	No rebound effects were identified.
Trade-Offs or Negative Effects	This technology does not appear to create other outsized or irreparable environmental or social impacts.
Carbon Burden from the Enabling Technology	Burdens included the embodied carbon emissions of the electronic equipment (i.e., manager and member controllers within the irrigation system) and electricity usage of these devices. These emissions are considered negligible compared to the energy savings from water savings and were not included because of lack of sufficient data.
Carbon Abatement Calculation	
Scope	The scope of the carbon abatement calculation included the 939 Lowe's sites at which HydroPoint technology was installed.
Timeframe	The calculations of carbon savings considered pre-and post-installation annual consumption data of the water management technology. The data reviewed by the Carbon Trust was made up of 2 data sets which included 542 of the 939 sites: • The first data set concerned 141 sites that installed HydroPoint technology starting in 2008 with most installing in 2010. Baseline year water consumption for each site (before HydroPoint installation) was compared to water consumption in 2013 (after installation of HydroPoint smart irrigation controllers). • The second data set concerned 401 sites that installed HydroPoint smart irrigation controllers in 2016. Baseline consumption in this case was calculated using an average across the years 2013-2015 and was compared to 2017 consumption to determine water savings. Water savings for the remaining 397 sites were estimated using conservative percentage savings figures, since these were either newly built sites, lacking full baseline data, or had not been in place for a full year in order to have annual savings figures. See the "Key Assumptions" section for the assumptions used to calculate the water savings at these sites.
Functional Unit	The functional unit for the GHG emissions reduction is metric tons of CO_2e (tCO_2e) per site. This was calculated by multiplying water savings per site in millions of gallons (MG) by the carbon emission factor (tCO_2e/MG) of the water used at each site.

Methodology	To calculate carbon emissions savings as a result of water savings, it was necessary to determine the life cycle emissions intensity of the water used at each site. The emissions intensity of a public water supply varies depending on the source of the water (i.e., ground source vs. surface), the topography of the land over which it is distributed (e.g., steep terrain requires more electricity to pump the water), the level of the water and wastewater treatment and the carbon intensity of the electricity grid that powers the water processing and pumping. State level data covering grid emissions factors (including transmission and distribution (T&D) losses)[10] and water source breakdowns for public supply[11] was used with assumptions of water levels and wastewater treatment which were based upon the standard practice of public water utilities in the U.S.[12] Energy usage figures for water distribution[13] and Well to Tank (WTT) emissions[14] were included in the calculation.
Key Assumptions	The following assumptions were made on the levels of water and wastewater treatment to determine the embodied emissions of the water at each site: • The energy intensity of water treatment included coagulation, flocculation, filtration, microfiltration and disinfection. All of these processes are considered standard for a public water supply.[3] • Tertiary wastewater treatment was assumed, as it is the most common degree of wastewater treatment.[15] Figures for the energy intensity (EI) of total water supply and wastewater treatment (including treatment and distribution) were calculated using data (given in kWh/MG) taken from a California Public Utilities Commission study.[13] Figures were given in this study for the EI of supply and conveyance from various sources, different degrees of water and wastewater treatment and water distribution. Although data from the study is state specific, we believe it is reasonable to assume that water supply and wastewater treatment practices are largely consistent across the United States. In order to be conservative, where ranges in energy intensity of water treatment, wastewater treatment, conveyance, etc., were given, lower bounds of these ranges were taken. All energy required to process the water used at each site was assumed to come from the local electricity grid. Some utilities may use fuel-powered pumps or systems, which are more carbon intensive than the grid. Likewise, they could also use electricity with a renewable energy guaranteed source of origin for all their operations, which would nullify the carbon intensity of the water. Having reviewed the energy usage of water utilities in the UK (which can be found in annual reports), it was apparent that using electricity from the grid is normal practice in water processing. Therefore, this assumption is reasonable and a more granular approach is not necessary.

10 EPA. (2016). Emissions & Generation Resource Integrated Database (eGrid). Retrieved from https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid

11 Molly A. Maupin, J. F. (2014). Estimated Use of Water in the United States in 2010. Virginia. Retrieved from https://pubs.usgs.gov/circ/1405/pdf/circ1405.pdf

12 Centers for Disease Control and Prevention. (2015, January 20). Retrieved from https://www.cdc.gov/healthywater/drinking/public/water_treatment.html

13 California Public Utilities Commission. (2010). Embedded Energy in Water Studies, Study 2: Water Agency and Function Component Study and Embedded Energy - Water Load Profiles. GEI Consultants/Navigant Consulting. Retrieved from ftp://ftp.cpuc.ca.gov/gopher-data/energy%20efficiency/Water%20Studies%202/Study%202%20-%20FINAL.pdf

14 DEFRA. (2017). Greenhouse gas reporting: conversion factors 2017. Retrieved from https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2017

15 Stanford Woods Institute, B. L. (2013). Water and Energy Nexus: A Literature Review. Water in the West. Retrieved from http://waterinthewest.stanford.edu/sites/default/files/Water-Energy_Lit_Review.pdf

	The amount of water consumed (i.e., deferred from treatment) was calculated using FAO data,[16] which published figures for the total municipal water withdrawal in the United States and the amount of treated municipal wastewater. This figure was used to determine the percentage of water supplied that was treated after use in municipal wastewater facilities. According to the Compendium of Sanitation Systems and Technologies, 2nd revised edition by eawag[17] , wastewater includes used water from agricultural activities, surface runoff or storm water. As mentioned under the "Timeframe" section, water savings were estimated for 397 sites since some installations were at new sites and others had not been in place long enough to have annual savings data. The newest 282 sites were installed by HydroPoint in early 2018. Estimations were calculated using the following assumptions for percentage savings, together with historic billing information to establish baseline consumption: • It was assumed that the 282 new sites would exhibit 25 percent savings. This is lower than the average savings from the rest of the portfolio (30 percent to 45 percent) because these sites are last to be installed and it is assumed the savings potential is less. The average emissions intensity factor across these sites was taken to be the weighted average of the emissions intensity factors of two data sets provided by Lowe's (these data sets covered consumption for 2009 and 2013 for 141 sites and for 2013-2015 (average) and 2017 for 401 sites). • An additional 30 sites have no baseline as they were installed as a new installation during store construction. These were also conservatively assumed to have a 25 percent water saving. • The remaining 85 sites were installed before 2013, but did not have accurate baseline data. It was assumed that the savings for these sites were consistent with the first data set (45 percent).
Exclusions	• The embodied carbon emissions of the electronic equipment (i.e., manager and member controllers within the irrigation system) and electricity usage of these devices. • Reductions in the emissions from site vehicles that are no longer required to physically visit control valves and controllers used by the irrigation system.
Data Sources	• California Public Utilities Commission. (2010). Embedded Energy in Water Studies, Study 2: Water Agency and Function Component Study and Embedded Energy - Water Load Profiles. GEI Consultants/Navigant Consulting. Retrieved from ftp://ftp.cpuc.ca.gov/gopher-data/energy%20efficiency/Water%20Studies%202/Study%202%20-%20FINAL.pdf • DEFRA. (2017). Greenhouse gas reporting: conversion factors 2017. Retrieved from https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2017 • EPA. (2016). Emissions & Generation Resource Integrated Database (eGrid). Retrieved from https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid • Food and Agriculture Organization of the United Nations. (2012). AQUASTAT. Retrieved from http://www.fao.org/nr/water/aquastat/wastewater/index.stm

16 Food and Agriculture Organization of the United Nations. (2012). AQUASTAT. Retrieved from http://www.fao.org/nr/water/ aquastat/wastewater/index.stm

17 Elizabeth Tilley, L. U. (n.d.). Compendium of Sanitation Systems and Technologies. eawag. Retrieved from http://www.iwa- network.org/wp-content/uploads/2016/06/Compendium-Sanitation-Systems-and-Technologies.pdf

	• Molly A. Maupin, J. F. (2014). Estimated Use of Water in the United States in 2010. Virginia. Retrieved from https://pubs.usgs.gov/circ/1405/pdf/circ1405.pdf • Elizabeth Tilley, L. U. (n.d.). Compendium of Sanitation Systems and Technologies. eawag. Retrieved from http://www.iwa-network.org/wp-content/uploads/2016/06/Compendium-Sanitation-Systems-and-Technologies.pdf • Stanford Woods Institute, B. L. (2013). Water and Energy Nexus: A Literature Review. Water in the West. Retrieved from http://waterinthewest.stanford.edu/sites/default/files/Water-Energy_Lit_Review.pdf • Centers for Disease Control and Prevention. (2015, January 20). Retrieved from https://www.cdc.gov/healthywater/drinking/public/water_treatment.html • Lowe's water consumption data for 2009 and 2013 for 141 sites. • Lowe's water consumption data for 2013-2015 (average) and 2017 for 401 sites.
Results	
Carbon Abatement Factor	Calculations concluded that installation of the HydroPoint solution produces annual emission savings of 0.80 metric tons of CO_2e (t CO_2e) per site annually. The average emissions intensity factor of the water equated to 1.14 tCO_2e/million gallons.
Water Savings Factor	Annual water savings from implementation of HydroPoint technology is approximately 680,000 U.S. gallons per site. Water savings were calculated using Lowe's water usage data before and after installation of HydroPoint Smart Controllers.
Insights	• Although this case study provides a good estimate of the carbon savings produced by the installation of HydroPoint, the carbon abatement factors do not take into account the size of each site. Including site acreage in subsequent studies, the result would produce an area-dependent carbon abatement factor and would improve comparability of the results. • The emissions intensity factor was cross-checked against emissions intensity figures posted by U.K. water utilities in their annual reports. Although the U.S. factors used in this study are smaller (as expected because of the conservative nature of the calculations), it was of the same order of magnitude. The average emissions intensity factor from selected U.K. water utilities was 1.94 tCO_2e/MG. • It must be noted that calculating the GHG emissions associated with the processing of water is subject to significant variability. For example, the relative mix of water sources (e.g., surface, ground, desalination) will vary throughout the year and between years, depending on changing meteorological conditions. Different regions within each state may also be affected differently by the same changes in meteorological conditions. • The energy required for the processing of the water could be examined at a utility rather than at a state level using assumptions on the levels of treatment pre- and post-installation, to increase the accuracy of the results. The data required to carry out this assessment was not available during this study.