in control

Water solutions for the world

The customer magazine of
ABB Power Generation & Water

No water, no life - no blue, no green

Making water and sanitation sustainable

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We are a leading provider of integrated power and automation solutions with unparalleled experience in partnering with the water and energy industries, bringing them improved operations and sustainable progress. We deliver integrated and secure digital systems, services and solutions to automate and optimize the performance of water facilities and conventional and renewable power plants.

IN CONTROL: EDITORIAL

Our world of water

KEVIN KOSISKO
MANAGING DIRECTOR
ABB POWER GENERATION & WATER

Water is the foundation of life on Earth. It covers almost three-quarters of the planet, forms more than half the human body and is even in the air we breathe. Without it, neither we nor the world would survive - our industries would grind to a halt, our food supply chain collapse and our bodies expire within days. It is our most important natural resource.

In this issue of In Control we focus on water. Not only as an industry for which ABB is a global supplier of solutions and expertise, but as a resource to be used sparingly and sustainably so that people's lives and livelihoods can thrive.

Among the topics we cover are the role of water and municipal utilities in smart cities, the challenges facing the water industry and how ABB solutions can help solve those challenges, a brief overview of our expertise and solutions portfolio and some of our headline references that demonstrate the strength of our skills and technologies, a look at how ABB can help companies achieve UN Sustainable Development Goal 6 targets for water and wastewater management, and how digitalization is revolutionizing water distribution through leakage detection and event management.

I am delighted to welcome to these pages Peter White, Vice President and Chief Operating Officer of the World Business Council for Sustainable Development. Peter represents one of the world's most influential forums on sustainable development and corporate social responsibility. His insights into the sustainability challenges the global water industry faces – and the opportunities that arise from those challenges – are illuminating and thought-provoking.

I am equally delighted to introduce Guido Jouret, Chief Digital Officer for ABB. Guido is a pioneer of the Internet of Things and is responsible for the development and deployment of ABB's digital solutions globally and across all businesses, including water. His knowledge of emerging technologies that could change the way the world uses water and how the water industry operates is instructive and insightful.

Enjoy your reading.

With kind regards,

Kevin Kosisko
Managing Director
ABB Power Generation & Water

INTERVIEW

No water, no life - no blue, no green

How can the world make better use of water, our most important natural resource? Guido Jouret, Chief Digital Officer for ABB, guides us through some of the emerging technologies that use water more sparingly and sustainably.

GUIDO JOURET
CHIEF DIGITAL OFFICER, ABB

Here's the challenge:
Right now, more than 500 million people globally are facing acute drought water shortages.

- Cape Town, South Africa, working around the clock to complete massive desalination plants, faces the imminent threat of its four million taps running dry. Nearby towns have water only on two "wash days" a week.
- Sixty percent of India's aquifers will be in critical condition within 20 years because farmers are drilling wells and using water faster than it's replenished.
- The Guarani Aquifer beneath Uruguay, Paraguay and Brazil – the second largest body of underground fresh water on Earth – is under threat of collapse from excessive drilling.
- Aug. 1, 2018 was the earliest Earth Overshoot Day since scientists started keeping track in 1968 – the point in the year when we consume more natural resources, water first among them, than the Earth can replenish in a year. Our current consumption rate is 1.7 planets per year.
- Within the next 30 years, there were will be 1.2 billion more people on the planet. Eighty percent of that swollen population will live in cities. The world's food system will require 50 percent more water; communities, cities and industry will need 60 percent more; and energy production will use 85 percent more water, according to the World Business Council for Sustainable Development.

It's no surprise the World Economic Forum says water crises are the biggest threat facing humanity over the next decade.

We understand the primary causes – climate change, poverty and inequality, and lack of rational water-use policies. What we need are solutions to provide clean water for our growing global population. Allow me to suggest a four-fold approach that's as simple as collecting rooftop rainwater, and as technically challenging as using the mighty Hoover Dam of the American West as the world's largest energy storage battery. Enabling most of these ideas is the growing power and capability of the globally connected, digital Industrial Internet of Things (IIoT).

Do the obvious stuff we're not doing now

Rooftop water collection + digital monitoring:
Water is heavy. Moving it somewhere to clean it, then using energy to send it back is wasteful. If energy generation and distribution is moving to rooftops, why not water too? Every time it rains, we're wasting clean water unless we collect and use it.

In Silicon Valley, where I live, many roofs are covered with solar panels, but I almost never see rain-capture systems. By my calculations, the San Francisco Bay Area – a famously drought-and-wildfire-prone region – could be 100 percent self-sufficient simply by capturing rain that falls on roofs during the winter rainy season. Nationally, I calculate the US could generate half the water we need through simple rain capture.

Amazingly, in many American states, it's illegal to use captured rainwater for one's home, for reasons ranging from sanitation worries to complex ancient water rights.

Digital technology could speed wise use of rooftop rainwater collection and use. A proper filtration system guarantees healthy drinking water from rooftop collection. As a homeowner I'd prefer to have an expert monitor my filtration system remotely, and dispatch repair people before they're needed, not after the system breaks down.

Fix the leaks:
Water brought to many cities at great cost is wasted by leaky pipes: 20 percent in the average city, 60 percent in Istanbul. In Vietnam, 30 percent of Ho Chi Minh City's freshwater supply has historically been lost to leaks and other infrastructure problems, but a current IIoT project involving my company, ABB, will reduce non-revenue water to 10 percent by 2020 by digitally monitoring the water network and instituting repairs in near-real time.

Make smarter use of wastewater:
In many places, 80 percent of municipal wastewater is discharged untreated. Singapore and Israel, to cite two examples, have learned to reclaim wastewater for drinking water and farming irrigation respectively. In many countries, though, even cleaned wastewater is prohibited for religious or cultural reasons. These restrictions can be honored and bypassed by building separate distribution networks for cleaned wastewater for use in irrigation and landscaping.

Rewind the clock. Start by reforesting the Sahara

There are radical "solutions" underway to address the world's water shortage. These include various forms of "terraforming" involving dumping lots of chemicals into the air or into the oceans. I worry they'll cause as many problems as they address. A wiser and safer approach, I'd argue, is taking place in Africa, where projects are underway to fight de-

sertification by putting back the trees and triggering a virtuous cycle of regeneration. The Green Belt Movement, founded in 1977 by the late Professor Wangari Maathai, has planted more than 51 million trees in Kenya.

A larger project, the Great Green Wall Initiative, triggered in part by Europe's migrant crisis and funded by $4 billion pledged by nations and non-governmental organizations at the 2015 Paris climate accord, stretches across 12 African countries and 7,100 km from Djibouti to Dakar. Together with measures to harvest rainwater, it is intended to allow farmers to grow crops all year round and create a new green lung of biodiversity.

"The Great Green Wall is not just a tree planting initiative," says Jean-Marc Sinnassamy of the Global Environmental Facility. "We are regenerating the whole landscape, tackling poverty as well as environmental degradation. Better ecosystems mean better vegetation cover (including more trees), better soils, better surface and underground water management, better productivity of lands for better livelihoods and income of rural communities."

These projects reintroduce the concept of a circular natural economy that nature provided long before the growth of human populations disrupted natural cycles. Imagine a replanted forest as a natural conveyer belt - water evaporates as sunlight hits the trees and returns as increased rainfall that irrigates the new forests and the farmland next to those forests. With viable ways to make decent livings, people would be less likely to migrate to distant European cities or be attracted in desperation to extremist organizations.

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Simply put, we are using too much water to make energy, and too much energy to deliver water.

Digital technology plays an important role here as well. It's important that local communities have clearly defined ownership stakes in new forests and farmland that will emerge. Satellites and GPS can accomplish that with precision. And the blockchain could create a foolproof chain of custody for the products of these new forests and farms, so local communities would get their fair share of the returns and not be tempted to waste the trees. I envision a new market of blockchain-enabled fair trade forests and farms that would guarantee traceability of, say, sustainable wood. So, a furniture manufacturer could market its products as coming only from sustainable forests, and be able to prove it.

Make water out of thin air

- Stimulating the virtuous local rainwater cycle is the goal of Waterboxx, by a Dutch company called Groasis that combats desertification, sinking water tables, erosion, hunger and poverty with a doughnut-shaped "plant cocoon" that grows trees in the desert using 90 percent less water than drip irrigation, until now the state of the art in water-sparing agriculture. Waterboxx collects condensation from morning mist, then seeps it to the tree planted in its center. Once multiple trees begin to grow at scale, they create more condensation and more moisture and begin the circular water economy. Groasis has reforestation, food production and ecosystem restoration projects underway on five continents. Its Waterboxx units can be digitally connected, monitored and coordinated remotely.
- WaterSeer, a device from a US company, looks like the world's smallest wind turbine and can pull 42 liters of water a day from the air with no need for an external energy source. It was recently nominated for the Katerva Award, which has been called the Nobel Prize of sustainability. A WaterSeer collection basin is buried 2.5 meters under the ground, with a pipe running from the basin to a small wind turbine that sticks out of the ground. The turbine draws air into the buried basin, where the air condenses into water because the surrounding earth at that depth is cooler than the surface. Networked, monitored, and coordinated, multiple WaterSeers can be linked into modular, self-contained water grids. One such water grid, in Saudi Arabia, harnesses climate change – a very hot country is becoming hotter and more humid as climate change takes hold – to produce 290 liters of water per day for irrigation.
- An engineer named Sonam Wangchuk, who grew up in an Indian stretch of the Himalayas bordering Pakistan and China, has invented human-made artificial glaciers that provide more than 9.84 million liters of freshwater runoff to alpine deserts that average just 10 centimeters of rainfall a year. Called stupas, named after local mound-like Tibetan structures, each artificial glacier is made of a 27.5-meter frame of wire and tree branches onto which water from glacial streams is pumped into the freezing air surrounding the frames. The water runs off when the stupas melt in the spring. In addition to the stupas in Tibet, others are being built in a Swiss skiing village to offset the lost runoff from a melting glacier. Wangchuck's stupas – "Ice Towers in the Desert," as the Swiss jury called them – won the 2016 Rolex Award for Enterprise.

Use the water-energy nexus to help us, not hurt us

Our dire water situation can be worsened or relieved by how we understand and use the water-energy nexus. Simply put, we are using too much water to make energy, and too much energy to deliver water. Threatened Cape Town relies primarily on energy from coal, which requires 87,000 liters of water a month to create power for a single home. In California, where I live, 20 percent of the state's massive energy production is used to move water from the Sacramento Delta in the north to the desert megalopolis of Los Angeles and Southern California. China moves water 1,500 km, the distance from Orlando to New York City. Even desalination – a promising remedy for water shortages – is energy-hungry. Half the cost of desalination, typically, is the energy required to run desalination plants.

What if we turned the water-energy nexus around, and used excess energy to deliver more water, and excess water to make more energy? What if we used the water-energy nexus as a form of battery-powered time machine?

I just mentioned that half the cost of desalination – widely considered a costly water-shortage solution – is the energy needed to run desalination plants. And with 98 percent of the planet's water stored in the salty seas, we are surely going to need desalination as global population increases. What if we could cut the cost of those plants by almost 50 percent?

Because renewable energy sources like wind and solar often produce far more energy than their grids can use, it is becoming common for the cost of energy for consumers to fall to zero, or even below zero. Since the beginning of 2018, the cost of energy has been zero or below 194 times in Germany, 76 times in California and 104 times in Australia, according to Bloomberg. Zero cost days have also occurred in Denmark, France, Switzerland, Texas and New England.

What can be done with excess energy? How can we store it for use at times when the sun isn't shining or the wind not blowing? Some companies, such as Tesla, are making utility-scale storage batteries, but their cost, according to a Lazard study, is currently 26 cents per kilowatt hour, compared with the typical price of 12.5 cents per kilowatt hour households typically pay for power. Until battery costs come down to become truly competitive, their use will remain limited.

But…what if a desalination plant could monitor energy prices and start up every time the price drops to zero? (The plant's energy cost wouldn't literally be zero due to transmission costs, but it would be drastically lower than retail prices.) And unlike ordinary people or businesses that can't store zero-cost energy without an expensive battery, desalination plants can store cheap energy by filling up their storage reservoirs when desalination is cheapest.

What if we could cut the cost of desalination plants by almost 50 percent?

In that way, desalination becomes a battery or time machine in the water-energy nexus. There are others:

- Norway's beautiful fjords are steadily becoming the "green battery of Europe" as neighboring European countries send their excess solar and wind power to Norway to pump water uphill to elevated reservoirs. When electricity demand increases and there's insufficient solar or wind power available, the fjord water is released to flow downhill and create hydroelectric power for European partners transmitted via low-loss high-voltage DC lines (HVDC, I'm proud to say, was an innovation of my company, ABB).
- Hoover Dam, the massive engineering marvel on the Colorado River – tall as a 72-story skyscraper – that in large measure enabled the development of the modern American West, is currently being

eyed as the world's largest battery. Los Angeles Mayor Eric Garcetti refers to the potential as a "once-in-a-century moment."

The idea is to build a pump station 30 km downstream from the dam, which would use excess solar and wind energy from California (that zero-cost energy again) to force water back upstream into Lake Mead behind the dam, where it would once again be released to create hydroelectric power when needed.

- Even the rotation of the earth – which accounts for time zones – can act as a battery. A large utility in North Carolina is currently building HVDC transmission lines to Texas, because when it's dark in North Carolina the sun's still shining in Texas and Texas can send North Carolina low-cost solar energy, not energy generated by burning fossil fuels. Similarly, China is building HVDC transmission lines from its north, where wind and hydropower are plentiful, to the cities of its south.

  All of this digitally-enabled time-shifting and terra-battery innovation is the beginning of what I see as a Global Energy Internet, which will traverse nations and continents to carry clean, renewable power from where it's generated at minimal cost (in money and climate destruction) to where it's needed most to help create, among other things, low-cost desalinated fresh water.

Will any one of these ideas, in isolation, solve the world's water problems and put an end to drought-driven migration, poverty-caused extremism or fights for precious resources? Of course not. But taken together – along with countless innovations not mentioned here or soon to come – they will put billions on the road to better lives.

For almost two centuries we have run our world with an Industrial Operating System that is clearly now killing its host. That is, OS 1 is killing us. It's our mission to harness the power of digital technologies to develop a new Industrial OS that meets the needs of the world's billions in water, energy, transportation and food. While all four issues are intertwined, water is a good place to start. As the marine biologist Sylvia Earle says, "No water, no life." ●

All of this digitally-enabled time-shifting and terra-battery innovation is the beginning of what I see as a Global Energy Internet.

INTERVIEW

“Our mission is to make sustainable businesses more successful”

The World Business Council for Sustainable Development (WBCSD) is one of the world’s most influential forums on sustainable development, sustainability and corporate social responsibility.

Peter White, WBCSD’s Vice President and Chief Operating Officer, gives his views on the challenges and opportunities in the water industry today.

PETER WHITE
WBCSD'S VICE PRESIDENT AND CHIEF OPERATING OFFICER

ABB In Control (IC): Taking a helicopter view of the global water industry, what are the main challenges facing water companies today and over the next few years?

Peter White (PW): On the global level, the water challenges are well known. According to the World Bank, within the next 30 years the world food system will require 40–50 percent more water; communities, cities and industry will need 50–70 percent more; and energy production will use 85 percent more water. By 2030 – only 12 years from now – the world will have a 40 percent gap between supply and demand if current levels of use continue.

But water is very much a local issue. It is context-specific. Some places have enough, others too little. So, we need to take a local approach to water. There are three main challenges in my opinion.

First, many of the solutions that companies provide are high-cost and high-tech, which their customers are not always willing to invest in. We therefore need more low-cost solutions for those countries and regions where affordability is a key issue.

Second, often there is insufficient information for companies to make good decisions on which solutions to implement. For instance, they often lack data on the complexity and variability of the effluent their facilities produce and how a change in product mix impacts the effluent. This limits the companies ability to select the best solution.

And third, underpinning both points is a lack of appreciation of the value of water by stakeholders, including governments, industry and communities. Getting these stakeholders to understand the true cost of water and the risks that arise from its depletion is the key issue going forward, both locally and globally.

IC: WBCSD runs many programs and projects to help realize the UN Sustainable Development Goals (SDGs). Can you tell us briefly about these programs and your initiatives to improve water management and achieve the UN SDG for water?

PW: We run five programs to help realize the UN SDGs. These programs are Food, Land and Water; Energy and the Circular Economy; Sustainable Cities and Mobility; People; and Redefining Value.

Water plays a key role in all these programs. By 2050 there will be 2.2 billion more people on the planet, all of whom will need healthy, nutritious food produced in a sustainable and water-efficient way. Reusing water to save the world’s finite sup-

plies of fresh water is part of our circular economy program. And, making cities smart and sustainable in areas like mobility, water and waste management is crucial, as two-thirds of the world will live in cities by 2050.

Our main objective is to help make businesses more sustainable and sustainable businesses more successful. We underscore the role that water plays in sustainability and business success. We do that in three ways. The first is raising CEO awareness of the importance of water and the risks that water scarcity poses for business operations. Second, we bring companies together so that they can deliver practical solutions to water problems. And third, we represent business in various policy and advocacy platforms at a global and regional level.

IC: Water is underpriced or subsidized in many countries, failing to reflect its true cost and value. Yet price hikes could lead to civil unrest in countries with subsidized prices, as has happened with petrol and bread. How can governments and water companies square this circle?

PW: The water sector knows that water is undervalued. Consumers, however, want their water as cheaply as possible or even at no cost. But effective pricing is the key to efficiency. And pricing should reflect the scarcity of the resource. Water companies should, therefore, charge a price that reflects the true cost of supply and production.

Governments and municipalities should already understand the need to recycle used water."

But raising prices does not necessarily lead to civil unrest. There are many ways to increase prices in a socially acceptable way. For instance, by volume consumed in which large-scale users like industry pay higher tariffs than small household users. Another example is for water companies to charge different rates according to the time of day or season, with higher rates for peak periods or the dry season when water is scarce. A good example of successful pricing is Singapore, where the rate is based on the size of the home and all consumers pay a water conservation tax. Thanks to both policies Singaporeans know that water is a precious resource.

IC: Eighty percent of municipal wastewater is discharged untreated, according to the UN. Reusing treated wastewater would significantly ease water scarcity. What should water companies do to increase water reuse?

PW: Governments and municipalities should already understand the need to recycle and invest in reclaiming used water. Again, Singapore is a good example of what can be done. The city's Public Utilities Board started producing high-grade reclaimed water called NEWater that supplies up to 40 percent of Singapore's needs.

Another example is the Dan wastewater treatment plant in water-stressed Israel, which treats municipal wastewater on a large scale to irrigate crops in the Negev Desert. This project not only stopped raw sewage from being pumped into the Mediterranean, it helped transform an arid desert into fertile farmland for fruit and vegetables.

IC: It seems the world is already in, or almost in, a global water crisis. How can water companies turn this crisis into business opportunities?

PW: There are several ways to turn water scarcity into business opportunities and many companies have demonstrated this. The main criteria are 1) make local solutions for local needs by understanding what the supply issues are and by using the right technologies to address them; 2) develop solutions that are efficient in terms of energy and materials and are, therefore, economically viable; and 3) make sure they are affordable for local users.

A good example is one of our member companies, Jain Irrigation, which has developed a range of low-cost micro-irrigation systems for smallholder farmers in India. One of Jain's innovations is a drip irrigation system for rice, which is a water-intensive crop grown in flooded fields. Jain's system is affordable for smallholders and produces a higher yield than conventional growing methods, from minimal amounts of water. It also has a high market potential worldwide.

IC: What can water companies do to improve water use and reuse by industrial and agricultural businesses?

PW: We covered this in earlier questions. One thing I would like to add is the need for cross-sectoral approaches that connect users in different sectors. For instance, municipal wastewater can be treated and reused in agriculture and industry, and industrial wastewater can be treated and reused to grow food. One sector can use another sector's wastewater, creating a win-win situation for both parties.

Companies within a sector can also exchange treated wastewater. Two of our members, ENGIE and BP in Western Australia, were faced with dwindling supplies of water and higher tariffs. Along with others they started a water reclamation program where unwanted wastewater from one company was treated and used as industrial water by another company. In one plant alone, this saved $1.5 million in costs and reduced the use of a scarce resource in a water-stressed area.

IC: The idea of smart, resilient cities is taking hold, especially among water utilities, which provide the fundamental services of any community – supplying and distributing clean water and removing used water. How can water companies help make their towns and cities smart and resilient?

PW: Cities are under increasing pressure. They face many challenges - in water supply, sewage treatment, waste collection and disposal, climate change and severe weather, greenhouse gas emissions, and transportation. Two WBCSD programs – Energy and the Circular Economy, and Sustainable Cities and Mobility – are directed at increasing the resilience of cities and in bringing companies together to develop smart solutions to these challenges.

Water companies are also under pressure from growing demand, fluctuating energy prices and aging infrastructure.

One way for water companies to deal with these pressures is with solutions that link suppliers with consumers. Smart metering is one example. Another is interactive websites through which consumers can track their water usage and learn conservation tips. These last two methods are effective if water is correctly priced, as consumers usually want to save money whenever possible.

Another way to increase city resilience is through technologies that reduce the use of fresh water, either by reusing wastewater, encouraging conservation or identifying leaks in aging distribution networks.

IC: How can ABB help its water industry customers live up to the UN SDGs, especially those on water and sanitation?

PW: Through innovation, new technologies and integrated solutions. And, by making water supply, treatment and management more efficient. All of these will contribute to SDG attainment in some way. To me this is a huge market opportunity for a company like ABB.

Whereas the business of some companies is to deliver on the SDGs - by supplying clean water, food, sanitation, etc., - ABB is clearly an enabler. It helps other companies contribute to the SDGs by making their operations more efficient. ABB does this across a broad range of applications, such as optimizing production, reducing pipeline leakage, cutting energy consumption and greenhouse gas emissions, predicting maintenance needs, and so on. Solutions like these enable others to provide clean water and effective water management.

IC: If you had to write a three-point plan on what water companies should do to improve water use and reuse, what would those three points be?

PW: First, is constant innovation, offering context-related low-cost solutions.

Second, working with customers - municipalities, industry, agriculture and domestic consumers – to increase their understanding of the value of water and to address water scarcity.

Third, reduce reliance on fresh water by using circular water management and technologies like desalination, because freshwater is limited and will not meet growing demand. ●

There are several ways to turn water scarcity into business opportunities and many companies have demonstrated this.

About WBCSD

The World Business Council for Sustainable Development is a global, CEO-led organization of over 200 leading businesses working together to accelerate the transition to a sustainable world.

Its member companies come from all business sectors and all major economies, representing a combined revenue of more than US$8.5 trillion and with 19 million employees.

WBCSD's mission is to accelerate the transition to a sustainable world by making more sustainable businesses more successful.

Its vision is to create a world where more than 9 billion people are all living well and within the boundaries of our planet, by 2050.

WBCSD was formed in 1992 and is based in Geneva, Switzerland, with offices in New York and New Delhi.

ABB is a founding member of WBCSD.

Read the WBCSD's 2018 CEO Guide to Water: Building resilient business, available at www.wbcsd.org

A few facts on water

There is water

Earth produces **a lot of water**, but it is not always available when and where people need it.

Less than 3% of the world's water is fresh – the rest is seawater and undrinkable.

Most of this **3%** is ice.

but it is fast disappearing

20% of the world's aquifers are already over-exploited, some critically so.

More than 40% of the global population will live in areas of severe water stress by **2050**.

Water demand is forecast to increase by **55%** by 2050.

and many go without.

1 in 4 people use contaminated water, putting their health and lives at risk.

Almost 20% of people live in areas of water scarcity.

Water- and sanitation-related diseases cost many countries up to **5%** of GDP in lost productivity.

69% is used for agriculture, **19%** for industry and **12%** for municipal use.

Leakage and losses range from **5-30%** in developed countries to as much as **50-70%** in developing countries.

Where does the water go?

Globally, **80%** **of wastewater** is discharged without being treated or reused.

How can we use water better?

Make every drop count

Reuse wastewater

Make irrigation efficient

Minimize leaks

UN Sustainable Development Goal 6
"Ensure availability and sustainable management of water and sanitation for all."

Source: UN Water
http://www.unwater.org/water-facts/

INTERVIEW

Making water and sanitation sustainable

United Nations Sustainable Development Goal 6 sets global targets for water and wastewater use and management.

How is ABB performing in its work to help achieve SDG 6 and how can it help water companies do the same?

Ingo Wagner, Head of Power & Water Systems at ABB, explains how.

INGO J. WAGNER
HEAD OF ABB POWER & WATER SYSTEMS

ABB In Control (IC): What makes ABB different in sustainability? How do ABB technologies help make a more sustainable world?

Ingo Wagner (IW): ABB is a leading contributor to a more sustainable world through its unique business offering of pioneering technologies and sustainable business practices. Our sustainability framework is based around issues highlighted by stakeholders and we have set ourselves ambitious 2020 targets across 11 environmental, social and governance measures.

Sustainable technologies lie at the heart of ABB's business. We have identified an eco-efficiency portfolio that delivers positive use-phase impacts in three areas: energy efficiency, renewable energy and resource efficiency. More than half of our global revenues come from this portfolio and it is growing year by year.

IC: Water is one of ABB's core businesses. What is ABB's vision for water and its value proposition for customers in the water sector?

IW: Our vision is to help water service providers deliver universal availability and sustainable management of water.

Over many decades we have developed a unique portfolio of skills and technologies that help water companies work toward this vison in all water applications.

These skills and technologies are based on our process expertise, integrated electrical and automation systems and life cycle services. They enable us to provide solutions that optimize water processes and reduce energy consumption, measure and monitor water quality, and minimize non-revenue water and leakage. Thanks to our global footprint we are well positioned to help customers meet local challenges and develop new business opportunities, sustainably.

IC: ABB has identified seven of the 17 UN SDGs where its solutions and expertise have the most impact. One of these is SDG 6: "Ensure availability and sustainable management of water and sanitation for all." How can ABB help water companies achieve their targets for SDG 6?

IW: The SDGs and their targets address the most important economic, social, environmental and governance challenges of our time and stimulate transformational changes. We recognize that achieving these goals requires businesses to contribute their fair share.

We identified seven SDGs where we can have the most impact. Our products, services and solutions not only enable SDG 7 (affordable and clean energy), which is one of our core businesses, but also SDGs 6, 8, 9, 11, 12 and 17.

We help water companies achieve their own targets for SDG 6 through our solutions for and expertise in optimizing processes, minimizing leaks and water loss in distribution networks and transmission systems. We also provide flood protection and smart sewerage solutions that prevent wastewater from becoming a sanitation problem during floods and downpours.

IC: ABB has production sites in 70 countries worldwide. As a major global company, what is ABB doing to reduce its use of water and improve water management at its facilities?

IW: ABB recognizes the urgency of reducing global water consumption. Currently, 70 percent of all industrial water and 43% of all cooling water at ABB worldwide is saved by reusing it through closed-loop systems. ABB has reduced its total water withdrawals worldwide by 10% from 2013-2017.

ABB is committed to reducing its water impact where it matters most. The 2020 target is to reduce absolute water withdrawals by 25 percent from 2013 at facilities in watersheds with medium to extremely high baseline water stress, as categorized by the World Resources Institute. By 2017 we had reduced consumption by 19 percent and are well on the way to reaching our target.

IC: There is a close connection between energy and water: water is used to produce energy, and power is used to produce, distribute and reuse water. How can ABB solutions and expertise help power and water companies improve efficiency in the energy-water nexus?

ABB has made digital the core of its business.

IW: Water applications are energy intensive. About half the cost of treating raw water and wastewater is energy. Up to 60 percent of the life cycle cost of pumping stations is energy. And desalination plants are often built with their own power plant to feed their huge need for power and steam.

ABB has developed products, systems and solutions that reduce energy use for all these applications, including power generation.

Pumps are just one example. They are everywhere in water applications – in plants, transfer schemes, pumping stations and distribution networks. They come in different sizes and capacities and use varying amounts of energy – the bigger they are, the more they consume.

By equipping the pumps with ABB high efficiency motors and variable speed drives, we reduce their energy consumption significantly, compared to running them with lower efficiency motors at constant speed. And we have a control solution for groups of pumps called PumpFit that selects the optimal number of pumps to run in a facility, instead of running them all at the same time, often unnecessarily. For energy-hungry pumps this reduces power consumption and maintenance and frees operators from manual operation.

IC: How is digitalization transforming the water industry and what should water companies do to harness the opportunities that digital offers?

IW: The water industry has been using digital solutions for years with SCADA and distributed control systems and smart metering. What is different now is that we have the technology to collect, aggregate and analyze vast amounts of data to improve performance, productivity and availability in a scalable way across a fleet of assets – water plants, distribution networks, transmission systems, pumping stations or sewage systems.

ABB has made digital the core of its business. Our ABB Ability™ portfolio of digital solutions, in harness with our expertise in water applications and digital technologies, delivers measurable value for customers. We work closely with our customers – in a spirit of collaboration - to understand their needs and provide solutions that solve their business challenges. These could be reducing energy consumption, minimizing leakage in water systems, controlling water quality or enabling preventive maintenance to reduce operation and maintenance costs.

For instance, we are providing a distributed control system with integrated leakage and event management for the water distribution network in Ho Chi Minh City, Vietnam. This digitally advanced solution will reduce non-revenue water loss from 30 percent to 10 percent in a rapidly growing city of eight million people.

IC: Collaboration with customers is a key component of ABB's digitalization offering. Recently, ABB opened a Collaborative Operations Center to provide water companies with advanced digital services. Can you briefly describe some of these services and explain why water companies should enter into deep collaboration with ABB?

IW: ABB's Collaborative Operations Center for Water is a pillar of our digital offering. It is one of several that ABB offers for industries in which it is a market and technology leader – power generation, oil and gas, mining, pulp and paper, and others. We currently operate three such centers for water in Italy, Singapore and Germany.

Collaborative Operations is a remote operations and maintenance hub that connects ABB with the customer's headquarters and production facilities, turning plant and fleet data into actionable information. Through a high-speed, cyber-secure connection to the plant's control system, we continuously monitor key performance indicators (KPIs) across a comprehensive suite of applications to ensure that each plant is operating within regulatory, environmental and cyber security requirements, automatically notifying the customer if a KPI is underperforming or a reference limit is broken.

Our ABB Ability™ portfolio of digital solutions, in harness with our expertise in water applications and digital technologies, delivers measurable value for customers.

This approach allows customers to benefit from our process and application expertise and deep field experience in maintenance. I expect water companies to gradually shift from on-premise solutions to Collaborative Operations in the immediate future. ●

ABB in top 10 companies of “Change the World” list

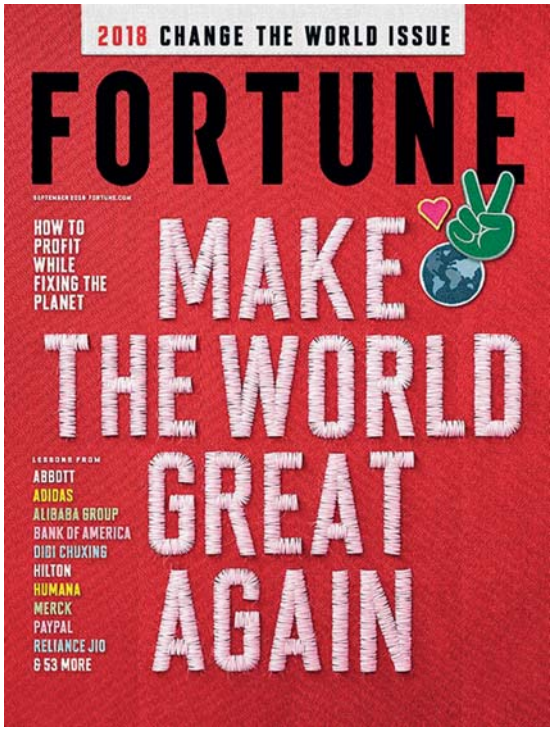
ABB has been named #8 in Fortune magazine’s “Change the World” rankings for the company’s efforts to speed up adoption of clean-energy electric transportation. The list, Fortune said, honors companies that “have had a positive social impact through activities that are part of their core business strategy.”

Other honorees included the drug maker Merck, for use of its life-saving vaccine against the Ebola virus this year in the Democratic Republic of the Congo. Fortune also lauded Reliance Jo, a telecommunications provider for providing the “digital oxygen” of smartphones and broadband to more than 200 million subscribers in India in less than two years.

ABB’s CEO, Ulrich Spiesshofer said the Fortune ranking was validation of the company’s leadership and commitment to e-mobility as a way to decouple global economic growth from climate change.

ABB, whose e-mobility portfolio includes charging and power solutions for trains, buses and ships, has developed fast-chargers for cars that can add as much as 200 kilometers (nearly 125 miles) of cruising range in as little as 8 minutes.

Fortune’s criteria for its “Change the World” rankings include the degree of innovation in a company’s technologies and the benefits to profitability and shareholder value from its positive social impact.



Challenges and opportunities in the world of water

What are the nine biggest challenges facing the global water industry and what can ABB do to to help resolve them?

The world's population is growing, and so too is the need for water, food and energy.

By 2030, there will be 1 billion more people on the planet and global demand for water could outstrip supply by 40 percent, according to the United Nations.

Not only is the need for water escalating, the utilities and companies that supply that water face major operational challenges daily.

1 Droughts and floods

Droughts and floods affect all regions of the world.

Droughts rarely impact an entire country. Often, water is available in some places, but not in others. Water transfer schemes solve this problem by piping water from areas of abundance to places where it is needed, easing the effects of drought. ABB has delivered many water transfer schemes, especially in the Middle East. Our latest project is the North-South Carrier in Botswana, where our solution automates and powers the pipeline and pumping stations that carry water from the north to the capital in the south.

Water and wastewater treatment plants are critical infrastructure. Even when storms flood coastal cities and rivers burst their banks, the plants must remain in operation, 24/7, whatever the conditions. In the Netherlands, ABB solutions control the Maeslant storm surge barrier, one of the largest moving structures on Earth, which protects Rotterdam and Europe's biggest port from flooding. And in Venice, our solutions control and power the MOSE flood barrier system to protect this iconic city from the devastating effects of annual storm surges.

2 Water scarcity

Unlike drought, which is occasional or periodic, water scarcity is permanent and ongoing. Water scarcity affects every continent and a fifth of the world's population.

As with drought, water transmission and desalination are effective solutions. In the United Arab Emirates, we provided a turnkey solution that almost doubled the capacity of the water transmission system between the Shuweihat desalination plant and the distribution network of Abu Dhabi. And throughout the Middle East, North Africa and other parts of the world we have provided automation, power and optimization solutions to ensure the reliable and cost-effective production of potable water from desalinated seawater.

3 High energy costs

Energy accounts for 55-60 percent of the life cycle cost of a pumping station.

ABB specializes in making pumping stations energy efficient. By equipping the pumps with ABB high efficiency motors and variable speed drives, we can reduce the annual energy consumption of a medium-sized pumping station by around 25 percent, compared to running it with lower efficiency motors at constant speed.

And, our PumpFit pump group control solution automatically selects the optimum number of pumps to achieve the lowest power consumption. This nets considerable savings in energy, extends the operating life of the pumps and releases operators from manual operation and monitoring.

4 Non-revenue water

On average up to 25-30% of a utility's water is lost in the network to leakage and other types of non-revenue water, according to the World Bank. These losses cost water companies vast amounts of money, not only in lost revenues but in the cost of treating and pumping water that leaks into the ground.

Leakage detection is a cornerstone of ABB's water expertise and offering for water transmission systems and water distribution networks. In collaboration with our partner, TaKaDu, our software-as-a-service solution uses advanced algorithms to detect, alert, manage and provide real-time insights into leaks, bursts and other water distribution network inefficiencies. Our exceptionally accurate leakage detection solution for transmission systems pinpoints leaks to within 3 percent of the source in pipeline segments that can be hundreds of km in length. We also offer a comprehensive range of water measurement products that measure flow, temperature, pressure, level and other variables essential to leak detection.

5 Financing

Many countries are overloaded with project financing and do not have the resources to handle more. Funding a water project, however much it is needed, is often not possible for the countries in question.

As one of the world's leading global companies in power, automation and industrial digitalization, ABB has the in-house financing expertise to raise funding for water projects worldwide. We collaborate with several banks and export credit agencies to finance turnkey projects.

6 Water quality

Consistent quality of drinking water and wastewater is a constant challenge for utilities. ABB is a leading supplier of digital measurement and analysis solutions for flow, pressure, level and quality, including conductivity, turbidity, pH, ammonia and phosphate analysis. The data from these industry-leading devices are generated into reports for regulators by our Symphony® Plus DCS/SCADA total automation system. The reports give minimum, maximum and average values across a broad range of intervals – hourly, shift, weekly, etc. – to meet all analytical and regulatory needs.

7 Water reuse

Whereas wastewater is cleaned and reused in many parts of the world, in others its reuse for agriculture is prohibited for religious or cultural reasons. This is now changing, opening up new opportunities for countries to recycle cleaned wastewater. To avoid religious or cultural constraints, this typically requires a separate distribution network for reclaimed water, which is then used for irrigation, watering green areas and other non-potable uses.

In Egypt, ABB recently provided a complete automation, instrumentation and monitoring solution for phase 1 of the water transfer system that provides New Capital, Egypt's newest city, with potable water. Discussions are ongoing with ABB for a separate distribution system for cleaned wastewater that the city can reuse for irrigation.

8 Shrinking tax base

In many countries, the revenues that water companies earn do not cover their operating costs. So, taxes have to make up the difference. Raising tariffs or introducing new taxes can cause political unrest and civil disturbances. The most effective way to avoid increased tariffs or taxation is to improve plant efficiency and reduce operating costs.

As the world's leading supplier of control systems, ABB has the automation know-how and process expertise to automate plants entirely. This reduces round-the-clock staffing to a single shift, which reduces operating costs by 7-8 percent in a typical mid-sized water plant.

ABB has automated many such plants, including treatment plants in Germany, the Netherlands and Norway.

9 Aging infrastructure

In the mature markets of Europe and North America, the number of water and wastewater plants is unlikely to increase. Rehabilitation is the strategy: the automation system is renewed every 10 years or so; instrumentation every 15 years; and electrical equipment every 20-50 years, depending on the type.

Because water and wastewater plants are critical infrastructure, rehabilitation must take place while the plant is in operation. Shutdowns are not an option. Few companies outside of ABB have the expertise to do this. In Germany, the Netherlands and the United States, as well as in parts of Asia, ABB has successfully performed rehabilitation projects of automation, instrumentation and electrical equipment without impacting normal operations. ●

What makes a smart city smart?

A smart city integrates its utilities and services into a unified system to improve efficiency, reduce operating costs and lower its carbon footprint.

Challenges and responsibilities

Half the world lives in cities. By 2050 that figure will rise to 70 percent, boosted by the 2.2 billion more people who will live on the planet at mid-century.

Cities generate 80 percent of global gross domestic product and swallow 75 percent of natural resources, producing around 80 percent of global greenhouse gas emissions. And as most cities are situated on coastlines, they are at high risk from the impacts of climate change, such as rising sea levels and powerful coastal storms.

Clearly, cities face many challenges.

As cities grow, they will need to boost their economies to sustain their booming populations. They must expand and renew critical infrastructure – for water and wastewater, energy, heating or cooling and transportation – while reducing their use of natural resources and cutting emissions. They must compete with other cities, domestically and internationally, for investment and talent. And they must deliver essential services like firefighting, policing and public safety to ensure the wellbeing of their citizens.

In response to these challenges, cities are setting themselves goals to improve their sustainability, quality of life and economic growth. Becoming smart and digitalized - especially in the use of energy, water and essential services - is the key to achieving these goals.

Vision, strategy and goals

A smart city provides quality of life for its citizens. It makes itself resilient to risk by driving sustainable economic growth and by integrating its utilities and services into a unified system to improve efficiency, reduce operating costs and lower its carbon footprint.

These utilities and services include power, water, wastewater, heating and cooling, as well as e-mobility infrastructure for vehicles, automation for factories and buildings, and networks for ultra-high-speed broadband.

Digitalizing smart cities separately, without a unifying vision, achieves limited results. The best outcomes are attained when they are coordinated in a smart city vision, with a common strategy and with clear goals based on the input of multiple stakeholders, including citizens, businesses and service providers.

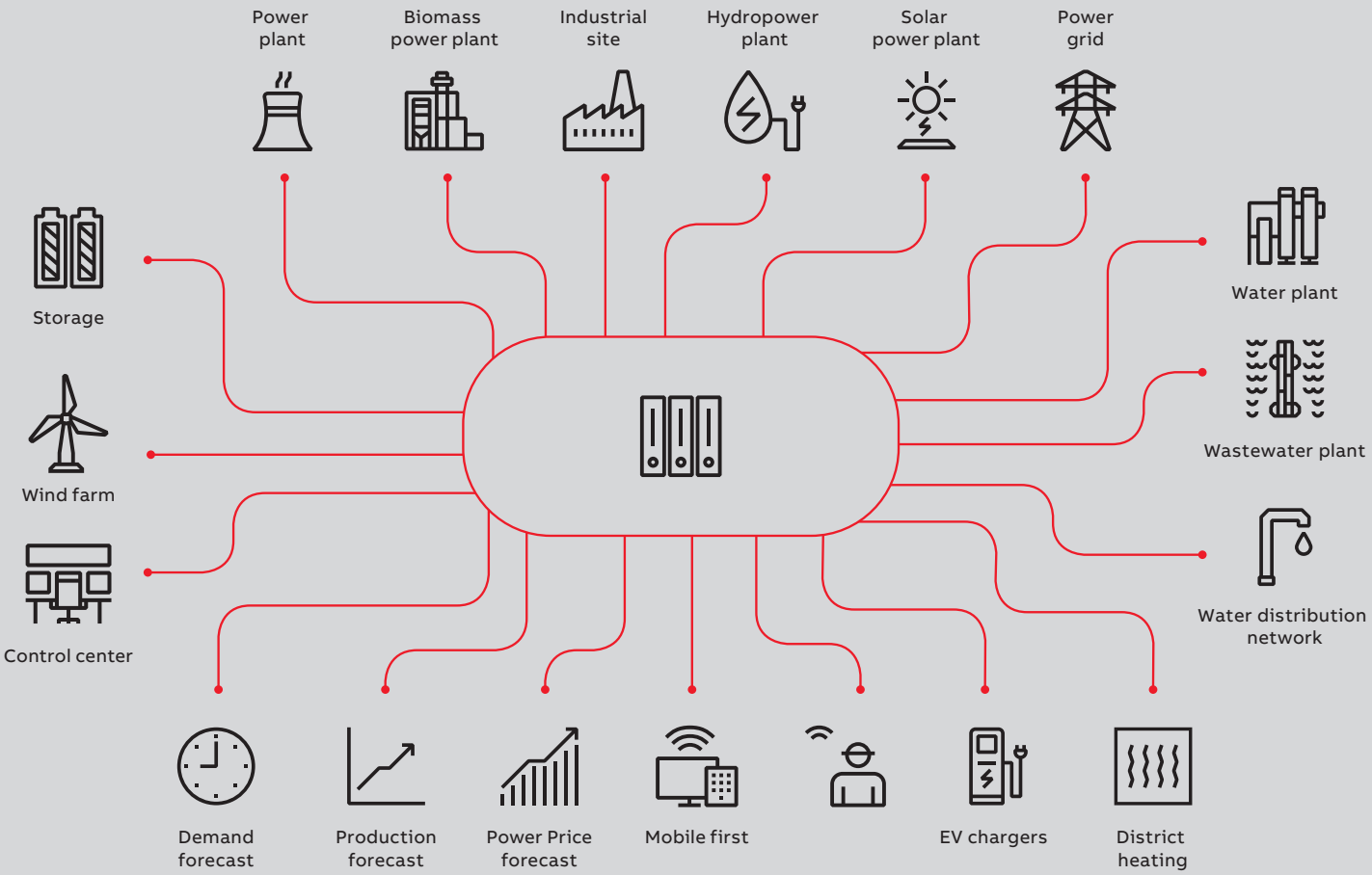
Digitalizing city utilities and services separately, without a unifying vision, achieves limited results.

Closing the loop

By interconnecting utilities and services like electricity, water and district heating, cities can unleash new powers of optimization that reduce operating costs, energy use and pollution.

For instance, ABB has developed solutions that coordinate the operations of municipal water/wastewater, district heating/cooling and power systems, enabling them to operate as a unified system within a closed loop system.

Here's how it works.



The many energy-hungry pumps in a water treatment plant and a district heating network do not need to run all around the clock. Even though the plant and network operate non-stop, the pumps can be scheduled to run when electricity prices are lowest, without risk of shortfall.

Typically, the combined heat and power plant that produces the heat, considers the electric power production as a by-product, which it sells without taking into account price shifts and market volatility. By optimizing production to meet market needs, it could maximize revenues by delivering power to the market at peak periods. Remember: the plant is powering the city's water and district heating pumps at off-peak times and has excess power to sell when demand is highest.

Enabling this solution are advanced ABB optimization algorithms that adjust network pressure and temperature, control pumps optimally, forecast heat and power requirements, and schedule production in line with demand and market prices.

Smart city solutions for Sweden

Earlier this year, ABB was selected by Swedish multi-utility Mälarenergi to develop smart city solutions for Västerås, Sweden's fifth largest urban area.

Mälarenergi operates hydropower plants, the local power grid, a waste-to-energy plant, heating and cooling networks, water and wastewater treatment plants, a water distribution network and a fiber-optic network for the city's 150,000 residents and businesses.

A key objective of the project is to integrate the control rooms of the many automation systems that manage the city's utilities and services into one unified operating environment. Another is to reduce the city's water losses in the distribution network by 20 percent and cut energy use by the district heating network.

Unified energy and water management

In Germany, one of the country's most progressive smart cities is Trier. There, the local municipality Stadtwerke Trier supplies electricity, gas, drinking water and district heating. It also treats wastewater and is responsible for the public transportation system.

ABB has already developed a smart energy management system for the city's diverse range of generation sources - wind power, hydropower, solar photovoltaic, biomass, combined heat and power (both large-scale conventional and micro CHP), as well as for battery storage, heat pumps, electric vehicle chargers and industrial loads.

The solution optimizes production, balances it with consumption and is connected to weather and load forecasting tools. It has the scalability and flexibility to seamlessly integrate new generation units, storage devices, vehicle charging stations and other loads without disruption to operations.

In a new project (Interreg VA EnergiewabenGR), ABB is working with Trier to connect the city to three other municipalities in France, Belgium and Luxembourg, each of which operates its own power pool of diverse types of generation and storage. The solution will enable the pools to compensate for fluctuations in renewable energy by exchanging power with each other and using storage capacity intelligently. This in turn will maximizes their use of renewables and minimize their dependency on the national grids.

Now, Trier and ABB are connecting the waste water plant, the water network, on-site PV generation and the CHP plant in a separate power pool to reduce operating costs. This is another instance of how the coordination of utilities and services – in line with the city's vision, strategy and targets - creates value for the municipality and its citizens. ●

ABB has developed solutions that enable municipal water, district heating/cooling and power systems to operate as a unified system within a closed loop.

EXCELLENCE IN DESIGN

The smart water revolution

External innovators can lend great impetus to new product development. By teaming up with just such an external partner – TaKaDu – ABB can now, in addition to its existing water business portfolio, offer water utilities solutions that leverage the full potential of digitization.

Victoria Lietha
ABB Technology Ventures
Zurich, Switzerland

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Hugh Courtney, President of the International Partnership of Business Schools, a consortium of leading business institutions that aims to elevate global business education, is credited with saying, "in a globally competitive economic environment, the only source of sustained competitive advantage has to come through innovation." Traditionally, the innovation that is so vital for new business development came from inside the business. In recent years, however, the speed, depth and complexity of technological development have forced enterprises to rethink their approach to innovation and seek inspiration from outside the company. In many cases, collaboration with external agents has become an indispensable strategy when trying to stay ahead of the competition. ABB has long followed such a path, with notable success.

The World Bank estimates global water loss due to leaks and bursts at 25 to 30 percent, representing a $20 billion cost savings opportunity.

In 2009, external collaboration was taken to a new level with the formation of ABB Technology Ventures (ATV), ABB's strategic venture capital investment arm [1]. Based in Zurich, Switzerland, Silicon Valley and Chennai, India, ATV partners and invests in breakthrough technology startups that drive strategic value for ABB.

ATV's partnership with TaKaDu, which dates from 2012, provides a perfect example of how an ATV investment can lead to a better offering and new customers.

Let's talk water

Water presents some of the world's most pressing social, political and economic challenges, and water crises rank among the top ten global societal risks in terms of impact, according to the World Economic Forum's Global Risks Report 2018 [2].

More concretely, the UN predicts that half of the world's population will not have access to clean water, enough water or water at all by 2030 should consumption and pollution issues not be adequately addressed. The factors contributing to more demand for water, such as climate change,

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Typically, utilities either have no data, or if they have it, they do not analyze it, depriving themselves of visibility into their water network.

population growth, new ways of living - and thus changes in domestic, commercial and industrial water consumption - are amplified by factors on the supply side.

Amir Peleg - "the hi-tech plumber"

At 51, Amir Peleg, who likes to call himself, "the hi-tech plumber," has a string of successful startups under his belt, among them YaData Ltd. (novel technology for behavioral targeting; acquired by Microsoft), Unipier Ltd. (formerly Cash-U) and EVS, (Elbit Vision Systems) Ltd. He founded TaKaDu Ltd. in 2008.

Amir Peleg holds a B.Sc. degree in Mathematics, Physics, and Computer Science from the Hebrew University of Jerusalem and an MBA from INSEAD (Institut Européen d'Administration des Affaires or European Institute of Business Administration), Fontainebleau, France - a graduate business school. As a youth, Amir Peleg won a special prize for young inventors from the Weizmann Institute, Israel.

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02 TaKaDu data analytics example.

On top of inadequate infrastructure investment, the World Bank estimates global water loss due to leaks and bursts at 25 to 30 percent, representing a $20 billion annual cost savings opportunity. Typically, utilities either have no data, or if they have it, they do not analyze it, depriving themselves of visibility into their water network. Repairs are carried out reactively and rarely in a planned way. Often, the first indication of trouble is when a concerned citizen reports water flowing down the street.

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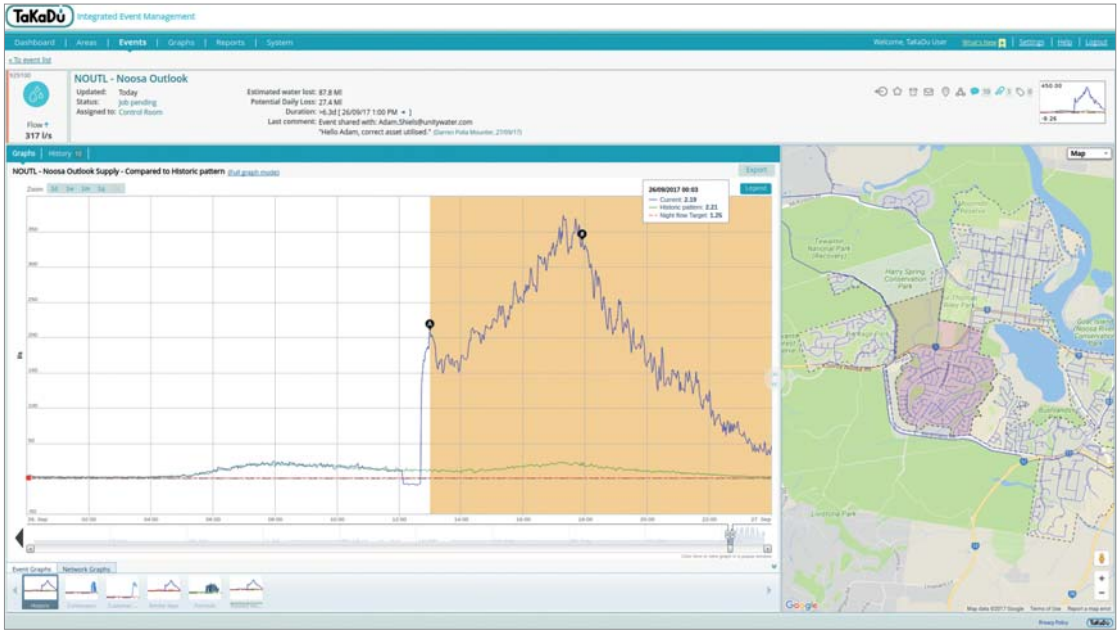
TaKaDu's solution analyzes and processes data that is captured by various smart sensors in the system equipment.

TaKaDu technology to save the day

The good news is that new technologies can help to solve the problem. By using digital technologies, data analytics and algorithms based on artificial intelligence (AI), utilities and cities are better equipped to manage demand for, and supply of, clean water and thus extract more value from their physical water infrastructure. Amongst the pioneers introducing these new technologies into the water industry is an Israeli company with which ABB's ATV has gone into partnership: TaKaDu [1].

According to Amir Peleg, Founder and CEO of TaKaDu, no one takes water for granted in Israel – a country in which water is in very short supply indeed →1. In fact, about 50 percent of Israel's drinking water comes from desalination plants – an expensive option – with agriculture irrigation using recycled wastewater (over 85 percent of Israel's wastewater is reused, the highest percentage in the world).

The trigger for Amir Peleg's venture into the water industry came around the time in summer 2008 when he had to reduce his own water consumption due to regional drought. He then found out that the local utilities were losing 15 to 20 percent of the water they were pumping into the network. On top of this, a chance conversation with an engineer brought home to Amir the realization of the inefficient situation in which many water utilities find themselves: Though they lose, on average, 25 to 30 percent of their water and collect a substantial quantity of raw data pertaining to their leaky water networks, very little use is made of this data to provide insight into the state of the water system or to support decision making. From this epiphany, TaKaDu was born.



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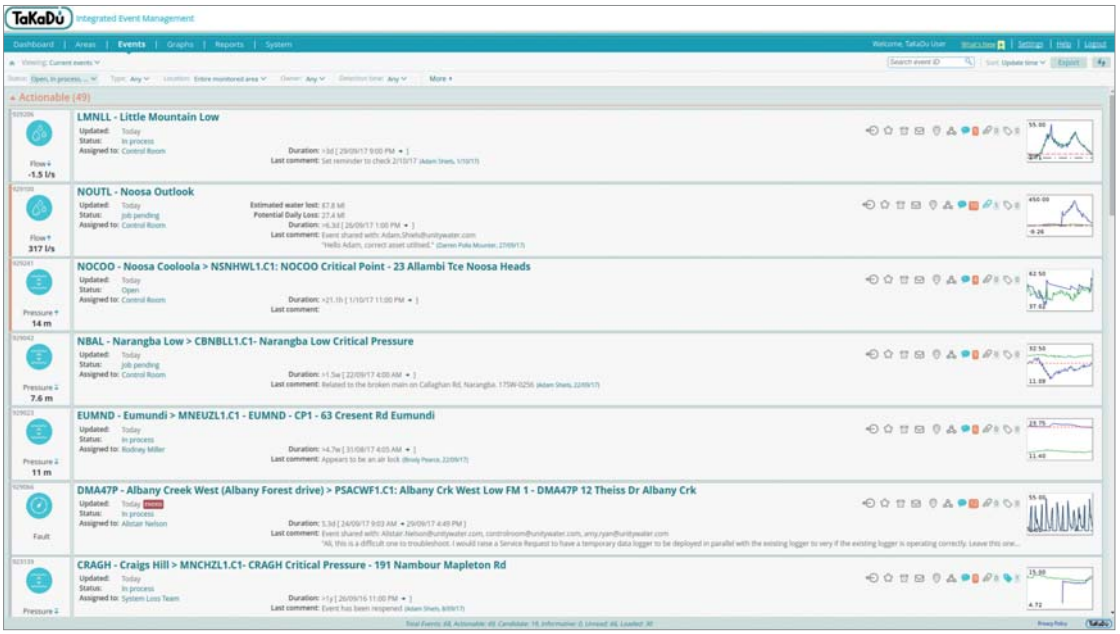
03 TaKaDu event management example.



03

Pipeline processing

Amir Peleg and his team started to develop algorithms and use statistical approaches to detect leaks and prevent big bursts in the water networks. TaKaDu's solution analyzes and processes data that is captured by various smart sensors in the system equipment. These multiple data sources include inputs from network operation and supervisory systems (eg, SCADA), online sensor-based flow meters, pressure data and other external influencers such as weather and calendar events.

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Multiple data sources are tapped by TaKaDu's patented, cloud-based SaaS to monitor optimal capacity, detect issues in the pipes, meters, valves, and other apparatus, and alert in real time on network faults.

The data is then used in TaKaDu's patented, cloud-based SaaS (software-as-a-service) to monitor optimal capacity, detect abnormal behavior of the data, classify these as issues ("events") in the pipes, meters, valves, and other apparatus, and alert in real time on network faults. While game-changing for utilities and smart water management, the solution does not require network changes, additional devices or capital expenditure. In summary, TaKaDu's approach can predict, detect, analyze and manage water network events, thus reducing costs and increasing visibility and efficiency →2-5.

How does TaKaDu's technology work? For each water network, or part thereof, the software determines a baseline of normal patterns. For example, it understands the pattern of the water flow by the time of the day, the weekday, the season, etc., and learns, for example, that demand is highest in the mornings and evenings before people go to or after they return from work; and that behavior is different over the weekend or during holidays. The more information that is available about normal water usage behavior, the more precisely the software can detect anomalies such as leaks, a burst or even water theft. At Yarra Valley Water, a utility in Melbourne, TaKaDu's software detected unusual activity at a fire hydrant; when officials turned up at the location they found a strawberry farmer extracting water from the hydrant.

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04 TaKaDu sample management dashboard.

A critical innovative step achieved by TaKaDu was to look at the whole process as managing different types of events and combining all information and knowledge about them in a single interface. To put it in Amir Peleg's words: "In a similar way to how customer relations management (CRM) software drives business relationships with customers in today's enterprise, integrated event management integrates all the data layers a utility has about its network into a single knowledge layer about every incident."

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The more information that is available about normal water usage behavior, the more precisely the software can detect anomalies such as leaks, a burst or even water theft.

The in-depth visibility, real-time detection and quick insights gained into every type of event include the identification of:

- Leaks before they turn into large bursts
- Changes and trends in water pressure or supply interruptions
- Anomalous usage patterns or water theft
- Water quality issues
- Faults in meters, valves, PRVs (pressure reducing valves) and other assets
- Telemetry and data availability issues
- Automatic early warning of operational issues, like open valves and zone breaches.

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05 TaKaDu - Typical leak event. Whereas ABB supplies instrumentation, control systems, sensors and measurement products, TaKaDu delivers an AI-based solution that provides early warning of the most likely leakage scenarios and tells the customer the optimal placement of the minimal number of pressure sensors.

According to Amir Peleg, many utilities are in a gray zone – they have some sensors and some analytics, and they ask why they should put in more sensors. But once they see the power of TaKaDu's product, they change their minds. The tailwind they get kicks off a positive feedback investment cycle.

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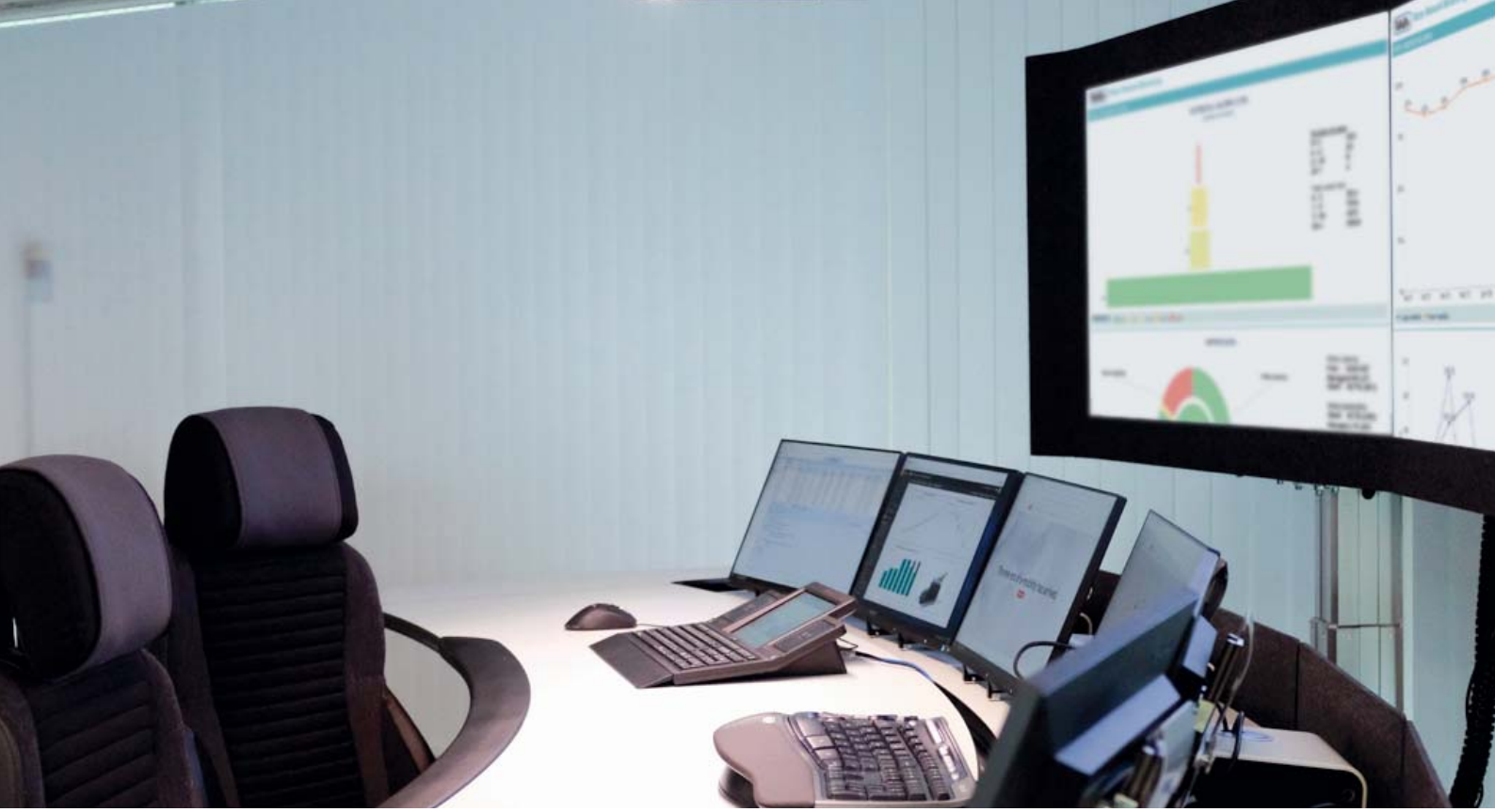
Complementing ABB's automation portfolio for the water sector, TaKaDu gives ABB access to its field-proven monitoring system, which has been widely adopted by water utilities.

Ho Chi Minh City

Complementing ABB's automation portfolio for the water sector, TaKaDu provides its field-proven monitoring system, which has been adopted by water utilities around the world. TaKaDu's innovations allow ABB's customers to produce, transport, distribute, treat and utilize water efficiently, reducing energy consumption, minimizing losses and improving reliability.

"TaKaDu's AI-based solution enables the water industry to catch the wave of digitalization for their sector just in time," says Kurt Kaltenegger, Head of Technology at ATV. "By partnering with TaKaDu we can show the full potential of advanced automation and the use of data to our customers in the water industry." While TaKaDu's solution helps to convert raw data into knowledge, ABB's long experience, established technology and broad customer base offer TaKaDu access and reach.

The powerful ABB/TaKaDu symbiosis is being put to work, for example, in a massive urban project to increase efficiency, reduce water leakage, prevent disruptions and ensure everyone has access to clean water in Ho Chi Minh City – a city that currently loses nearly 50 percent of its potable water to leaking and damaged pipes.



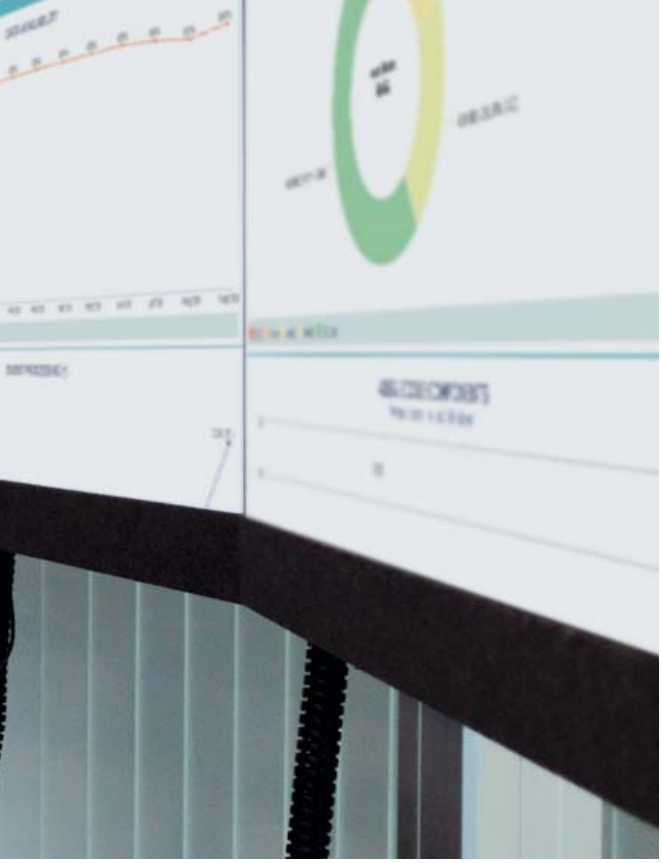
The Saigon Water Supply Corporation (SAWACO) is deploying ABB's digital control and monitoring technologies together with TaKaDu's Integrated Event Management Solution as part of its restoration of Ho Chi Minh City's water distribution network.

The Saigon Water Supply Corporation (SAWACO) is deploying ABB's digital control and monitoring technologies together with TaKaDu's Integrated Event Management Solution.

The ABB solution – ABB Ability™ Symphony® Plus SCADA – will monitor and control the entire water distribution system and integrate TaKaDu's Event Management solution, which detects, analyzes and manages network events and incidents such as leaks, bursts, faulty assets, telemetry and data issues, and operational failure 6.

ABB's and TaKaDu's complementary solutions will enable SAWACO to monitor the network conditions digitally through multiple data collection points, such as sensors and meters, and offer actionable insights to reduce non-revenue water. SAWACO will then be able to increase the amount of water delivered to the city's industries and eight million residents →7. At a first estimate, SAWACO will hit 50 Mio m^3/year of water savings - equivalent to 20,000 Olympic-size swimming pools - while annual production cost savings could exceed $10 million.

"We're excited to partner with ABB on this project in one of Asia's most dynamic countries," said Amir Peleg, "By converting raw data into knowledge, we can help SAWACO reduce hundreds of thousands of cubic meters of non-revenue water lost per day while significantly improving operational efficiency."



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06 Water network management is just one application of SCADA. Over the years, ABB's SCADA has evolved to fit specific business needs in many different areas.

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07 TaKaDu's technology transforms a water utility's approach to crisis management from one of ad hoc reaction into one that is data-driven and with more efficient decision-making.

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References

[1] V. Lietha, "In search of strategic innovation and collaboration," ABB Review 1/2018, pp 8-12.

[2] World Economic Forum, "The Global Risks Report 2018." Available: https://www.weforum.org/reports/the-global-risks-report-2018.

[3] www.takadu.com

Charting future waters

From its successful beginning, TaKaDu's technology has gone from strength to strength. The company has transformed water utilities from being reactive entities with ad hoc crisis management into data-driven, efficient decision-makers. TaKaDu's technology is now deployed in 12 countries worldwide, including Australia, Brazil, Chile, Israel, Romania, Spain and the United States, and customers include every type of water utility: small, super-large, rural, urban, private and public.

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TaKaDu's solutions have been internationally recognized as environmentally friendly technology.

TaKaDu's solutions have been internationally recognized as environmentally friendly technology - even winning the Technology Pioneer award from the World Economic Forum. TaKaDu also participated in a panel that discussed water scarcity in front of world leaders at the annual meeting in Davos. However, it was investment in the company that allowed its vision to evolve. On that note, on May 21, 2014, ATV won the Global Corporate Venturing award in the Sub-$50-million Investment of the Year category for its investment in TaKaDu. The awards celebrate innovation, best practice and service in the corporate venturing ecosystem. Among others in the running in the category were Google Ventures, Amex Ventures, Intel Capital, and Nike – further distinguishing ABB as an internationally recognized, innovative and strategic leader and underlining that the ABB/TaKaDu collaboration is a clearly successful and symbiotic relationship. ●

07

Water solutions that make your business better

10 strong reasons for choosing ABB as your partner and solutions provider

1 Why ABB

We offer a comprehensive portfolio of advanced automation, instrumentation, electrical, optimization and service solutions for all water applications, with unrivalled process expertise, market and technology leadership in industrial digitalization, and a strong global footprint with operations in more than 100 countries.

2 Applications where we make the difference

- Desalination plants
- Water treatment plants
- Wastewater treatment plants
- Water distribution networks
- Irrigation systems
- Water transmission systems
- Pumping stations
- Waterways and coastal protection

3 Integrated automation and electrical solutions

We provide complete and fully integrated instrumentation, control and electrical (ICE) packages for all water applications and cover the entire project life cycle from design and engineering to installation and commissioning.

ABB has a truly comprehensive portfolio of digitally enabled power, automation and instrumentation products, ranging from motors and drives to transformers; high, medium and low voltage equipment; measurement and analytics devices and wireless communication networks.

4 World leader in digital and control

Thanks to our strong industrial focus, ABB has the world's largest installed base of digitally enabled and connected devices:

- 70 million digitally enabled devices
- 70,000 digital control systems
- 6,000 enterprise-level software solutions
- 50 cloud-based services and analytics

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01 Västerås, Sweden

We are also the world's leading supplier of distributed control systems., both in general and in industries like oil and gas, pulp and paper, mining and metals, and power generation.

With around 20% market share across industries, ABB is the leader in digitally enabled control and automation, according to industry analysts, ARC Advisory and Frost & Sullivan.

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5 Total automation for water facilities

ABB Ability™ Symphony® Plus is one of the most widely used DCS and SCADA systems in water applications worldwide.

Symphony® Plus maximizes efficiency and reliability through automation, integration and optimization of the entire plant, network or facility. It provides simple, scalable, seamless and secure total plant automation, including tight integration of all control equipment and geographical information systems.

Symphony® Plus is part of the ABB Ability™ portfolio of unified, cross-industry digital solutions that enable businesses to harness the power of industrial data and generate actionable insights that help them drive performance and productivity improvements.

With its built-for-purpose platform, Symphony® Plus satisfies performance objectives in operations, maintenance, engineering, IT and management. And it meets the key focus areas of markets served - plant productivity, energy efficiency, operational and cyber security, plant safety and cost of ownership.

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6 Smart cities need smart utilities

Digitalization enables water companies to manage their assets more efficiently and integrate their plants and networks with other municipal services to create a smart city that uses resources optimally to improve residents' wellbeing.

ABB solutions help water companies become smart – through digitalization, advanced SCADA and distributed control systems, measurement and analytics, communication systems, energy efficiency, pump optimization, leak detection and event management, and predictive maintenance.

For instance, in the city of Västerås, Sweden, we are developing smart city solutions with multi-utility Mälarenergi to optimize its water, wastewater, power and district heating networks, reduce energy use and non-revenue water, and create new consumer apps and services to enhance the wellbeing of the city's residents and the success of its businesses.

7 Advanced optimization

ABB advanced digital services include a suite of optimization solutions to increase productivity and production flexibility, enable predictive maintenance and improve availability, and optimize setpoints, schedules and asset life cycles. These widely proven and industry renowned services include:

OPTIMAX® Membrane Performance
Monitors and predicts reverse osmosis membrane fouling status, determines when cleaning/flushing is required and tunes parameters to maximize production, reduce operating and maintenance costs and extend membrane life.

TaKaDu Water Infrastructure Monitoring
In collaboration with our partner, TaKaDu, our software-as-a-service solution uses advanced algorithms to detect, alert, manage and provide real-time insights into leaks, bursts and other water network inefficiencies.

Water transfer leakage detection
Detects leaks to within 3 percent of the source in pipeline segments, which can be hundreds of km in length, thereby minimizing loss, simplifying maintenance and reducing operating and service costs.

PumpFit pump group control
Optimizes the number of running pumps within a pump group to minimize power consumption and release operators from manual operation.

PEMS pump efficiency monitoring system
Provides real-time information on mechanical pump efficiency – independent of pump operating point, flow, succession and delivery pressure – to give insight into the health of the pumps or pumping stations.

8 Collaborative Operations

Close collaboration between partners is vital to reap the full benefits that digitalization and data analytics offer.

Our ABB Ability™ Collaborative Operations Center for Water connects ABB with the customer's HQ and production facilities, turning plant and fleet data into actionable information.

We combine:
- Process engineering knowledge
- Water application expertise and deep field service experience

with digital technologies to create remote-enabled interactive environments that provide:
- Incident identification
- Predictive notification of imminent events, and
- Detailed data analytics

The center is connected to almost 700 customer sites, delivering a broad suite of advanced services in asset health, predictive maintenance, performance optimization and cyber security.

9 ABB Water Care service

ABB Water Care is a complete service offering that raises the performance of the plant's automation and electrical assets, its operations and maintenance staff, and the production process during the life cycle of the facility.

Our life-cycle approach to plant and fleet service:
- Improves plant performance and reliability
- Extends asset and plant operating life
- Protects equipment and intellectual investments
- Brings budget stability and predictability
- Supports plant operations and engineering staff

10 Your partner across the complete life cycle

Consultancy — **Engineering** — **Supply** — **Installation** — **Commissioning** — **Life cycle service and collaborative operations**

ABB Ability™ Symphony® Plus

Total plant automation for water

Symphony® Plus provides simple, scalable, seamless and secure total plant automation for the benefit of all its users:

Simple
- Simple system architecture serves the diversified plant fleets of water companies
- Simple workflow automation to engineer, configure, secure, commission and maintain the entire system

Seamless
- Seamless integration of all plant devices and systems - automation and electrical, business and maintenance
- Seamless and incremental integration of new products, technologies and functionalities

Scalable
- Scalable control platform to automate all areas within the plant
- Scalable and flexible system architecture to support small, large and multi-system configurations

Secure
- Secure and reliable control environment to prevent unauthorized access
- Secures previous investments in control system assets and intellectual property

SPECIAL PRODUCTS FOR WATER

ABB Leakage Detection and Localization for water transmission pipelines

ABB's field-proven leakage detection, localization and management solution helps water companies improve the performance of their transmission network in real time, through comprehensive leakage detection and localization, leak size analysis and reporting. It identifies and locates failures at an early stage of their development, offering intelligent alerting capabilities and shutdown mitigation strategies.

Features

- Enables operators to monitor and manage losses throughout the pipeline network
- Reduces non-revenue water flows, energy costs and damage from bursts
- Detects leaks through multiple model- and non-model-based methods
- Locates leaks and bursts instantly, based on real-time data and model-based methods

Benefits

- Detects and locates leaks and bursts as they happen
- Supports the development of effective repair strategies to reduce maintenance costs
- Minimizes the duration of shutdowns

SPECIAL PRODUCTS FOR WATER

Pump Efficiency Monitoring System (PEMS)

ABB's patented Pump Efficiency Monitoring System (PEMS) provides detailed real-time information on pump string efficiency using a thermodynamic measuring method. Analysis of recorded pump efficiency supports condition-based maintenance and determines the best balance between reactive and predictive maintenance. This reduces unplanned shutdowns and costs.

Features

- Provides detailed real-time information on pump efficiency and flow to:
  - Optimize maintenance and replacement intervals to reduce costs and increase availability
  - Optimize pump dispatch and operation to maximize efficiency and minimize energy use
- Eliminates the need for magnetic flow meters in new plants
- Easy to commission, thanks to simple system configuration and easy installation with interface to the existing control system

Benefits

- Provides rapid and detailed information on pump efficiency
- Optimizes maintenance intervals and reduces plant downtime
- Saves time and costs in comparison with conventional methods
- Protects capital investment by getting the best out of the pumps

SPECIAL PRODUCTS FOR WATER

PumpFit pump group control

PumpFit optimizes the number of running pumps within a pump group to minimize power consumption and release operators from monitoring decisions and manual operation.

Features

- Defines the optimum number of running pumps at the most efficient operating point and reduces power consumption
- Automatically runs all pumps within the upper and lower limits and NPSH
- Releases operators from monitoring decisions and manual operation, while improving protection significantly
- Calculates flow for individual pump units and the pump group in case no flow meter is available
- Automatically aligns pump operating hours in the group
- Visualizes information for the operator to simplify monitoring

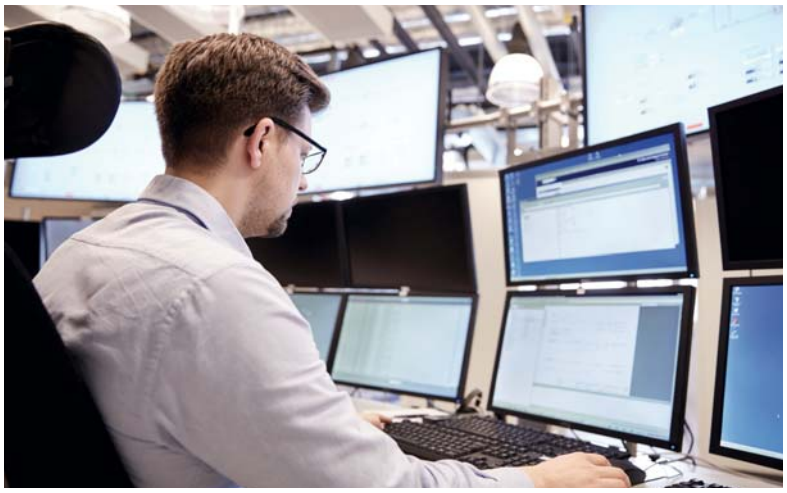
Benefits

- In operating scenarios PumpFit has:
  - Reduced energy consumption of a group of four pumps by almost 40%
  - Doubled pump group efficiency to 77% by switching from one-pump-operation to three-pump-operation

SPECIAL PRODUCTS FOR WATER

ABB Aqua Reporting Package

ABB Aqua Reporting Package information management system is specifically designed for water applications. Available as a standalone product or integrated with ABB' Symphony® Plus SCADA system, it provides multiple report templates for both real-time values and periodically calculated values. A laboratory HMI allows for the manual input of laboratory values and backward historical calculations.



Features

- Integrated and customizable real-time data archiving (>10 years) and reporting system to meet regulatory demands
- Visualizing and analyzing process parameters with an intuitive user interface
- Multiple adaptable Excel-based report templates for real-time or periodically calculated values and (waste) water quality calculations (incl. backward calculations)
- Combines process values, deferred (waste) water lab analysis measurements from the laboratory information management system (LIMS) and manual value substitutions in one solution

Benefits

- Reduces costs by providing critical information for the right person at the right time
- Advanced reporting functionality to meet regulatory demands
- Flexible Excel-based system meets the requirements of plant, service and operational managers
- Automatic archive correction after laboratory values input and powerful calculation engine for real-time and historical data

SPECIAL PRODUCTS FOR WATER

New AquaMaster4 electromagnetic flowmeter

In 1988 ABB introduced AquaMaster, the world's first battery-powered electromagnetic flowmeter for district metered areas (DMAs), which revolutionized the accuracy and control of water distribution. Features such as SMS messaging and solar and wind power were added, and over time the AquaMaster series became the go-to solution around the world for important challenges like leakage detection, helping save trillions of liters of potable water worth millions of dollars. Now, the latest generation AquaMaster4 flowmeter builds on this legacy with new digital technology.

Features

- Measurement parameters: flow rate, flow velocity, volume flow (forward, reserve and net) and pressure (option)
- Wide range of sensor styles and size: reduced bore DN40 to 600, full bore DN40 to 2400 and probe 300 to 1000 mm. Range up to R1000 and accuracy up to ±0.2% ±0.5mm/sec, whichever is greater
- Power options: 10 years battery life, solar/wind renewable and AC mains
- Communication options: Pulse, Modbus and Sensus with wireless interface to mobile smart phone/tablet
- Verification: in situ diagnostics and self-checking capabilities
- Drinking water certifications: WRAS, NSF, ACS, AS/NZS 4020

Benefits

- Invest smartly in "single box" DMA solution – combining flow, pressure and data-logging
- Have maximum confidence in your billing based on highest accuracy with widest flow range revenue meter, plus get early warnings for leaks or bursts and reduce non-revenue water
- Have highest confidence in the wet calibration – our flow rigs are certified by various national independent accredited bodies and laboratories, all linked by the International Laboratory Accreditation Cooperation (ILAC)
- Fit and flow with factory default settings - minimal on-site configuration required with quick and easy configuration through ABB Velox smartphone/tablet app
- Unique sensor design adjusts the flow profile for excellent meter performance in poor hydraulic conditions
- Lowest total cost of ownership over complete product life cycle

SPECIAL PRODUCTS FOR WATER

ACQ580 drives for water and wastewater

Low voltage ACQ580 drives for water and wastewater ensure continuous, reliable motor control when pumping water. The drive is used in water and wastewater treatment plants, pumping stations, desalination plants, industrial wastewater facilities and irrigation environments. The ACQ580 is easy to commission and use with the intuitive Hand-Off-Auto control panel. With several built-in pump functionalities, the drive keeps the pumping system operating optimally throughout its whole life cycle, reducing energy use.

Features

- Several built-in functionalities for optimal pumping
- Intuitive Hand-Off-Auto control panel with Bluetooth connectivity
- Compact and robust design for demanding environments (enclosure class up to IP55)
- Supports virtually any kind of low voltage motor
- Connects to a wide range of water and wastewater control systems

Benefits

- Helps lower the energy bill
- Effortless to commission, configure and use
- Reduces stress on the pumping system
- Easy to access remotely via the cloud

SPECIAL PRODUCTS FOR WATER

High voltage modular induction motor, type NMI

ABB's modular induction motor, type NMI, is optimized to meet the needs of the power and water industries. It provides a cost-efficient solution for pump and fan applications.

The NMI motor belongs to ABB's N-series general purpose motors. N-series general purpose motors combine cost-efficient standardized designs and short lead times with safety, productivity, energy efficiency and reliability. They are targeted at applications where a highly customized motor is not needed.

Features

- Welded steel frame
- Rated from 315 to 8,000 kW
- Available in shaft heights from 400 to 630 mm
- Voltages up to 13.8 kV
- Horizontal or vertical mounting
- Vertical mounting is specifically designed for vertical, condensate and circulating water pumps

Benefits

- High power density enables the motor to provide the same output power with a smaller frame size, which means less weight, a smaller installation footprint and lower costs
- Reliability is ensured by proven core technology and low vibration, resulting in high productivity
- Easy to integrate into the process due to its compact design, interface flexibility and low noise
- Pre-engineered platform ensures short delivery times and on-time delivery
- Complete portfolio of services covering the entire product life cycle, and spare parts availability

A more measured world of water

Water loss from leaking infrastructure is a serious issue in many countries, with some losing over 2 trillion gallons per year. Find out how the new AquaMaster 4 delivers a complete District Metering Solution (DMA) to help create sustainable infrastructure.

Want to learn more? Visit **abb.com/measurement**

Helping our customers make a difference

10 headline ABB water solutions from around the world and across the applications.

Silicon Valley, California

Making sewage safe in Silicon Valley

- Modernizing the largest wastewater treatment plant in the western United States
- Part of a $1.4 billion program to ensure the 60-year-old plant remains efficient, reliable and sustainable

ABB solution: Upgrade the facility's control system to state-of-the-art ABB Ability™ Symphony® Plus, without interrupting production

End customer: San José-Santa Clara Regional Wastewater Facility

Minera Escondida, Chile

Saving fresh water in the world's driest desert

- Seawater is desalinated at two reverse osmosis plants on the coast, pumped through a 177 km pipeline and four large pumping stations to the mine, 3,200 m above sea level, stored, then used across the site
- Enables the world's largest copper mine in the world's driest desert to minimize its use of fresh water from aquifers

ABB solution: An ABB Ability™ control system for the desalination plants, water transfer system, and water distribution network (including leakage detection). The system is fully integrated with the mine's ABB Ability DCS

End customer: BHP Billiton

Mälarenergi smart city project, Sweden

Smart city solutions for Swedish multi-utility

- Develop digital solutions to improve efficiency, reduce operating costs and enhance customer satisfaction with the municipal utility
- Includes reducing water losses in the distribution network by 20%

ABB solution: Provide expertise, cloud infrastructure, data processing and analysis for nine projects across Mälarenergi's operations

End user: Mälarenergi

Venice, Italy

Protecting Venice from floods and high water

- 78 retractable air-filled steel flood gates protect this fragile UNESCO World Heritage city from rising sea levels, winter storms and spring tides
- Largest public works project ever in Italy

ABB solution: The entire flood protection system is automated and controlled by an ABB Ability™ Symphony® Plus control system, managing data signals from more than 50,000 subsea and surface devices, and powered by integrated ABB electrical systems

End customer: Consorzio Venezia Nuova

Egypt

Water for Egypt's new capital city

- Egypt's new capital city will be home to 12 million people when finished in 2022
- ABB is providing a water management solution for about a third of the city

ABB solution: ABB Ability™ Symphony® Plus SCADA system - including advance leakage management and predictive maintenance systems - to minimize non-revenue water, predict water availability and optimize supply, predict faults and minimize maintenance costs, and ensure network operations are safe and sustainable

North-South Carrier, Botswana

Transferring water across Botswana

- The NSC carries water 360 km from reservoirs in the north to the capital Gaborone and surrounding area in the south, which are water-poor
- A second pipeline and pumping stations will double NSC's capacity

ABB solution: Integrated electrical, control and instrumentation for the second pipeline and pumping stations

End user: Water Utilities Corporation

Hong Kong

Treating Hong Kong's wastewater

• Plant expansion increases capacity by 45% and stops discharge of untreated wastewater into Victoria Harbour
• One of the world's largest wastewater treatment complexes, serving 5 million people

ABB solution: Upgrade the existing plant's DCS and integrate it with the new plant's DCS, creating a unified control system for the whole complex and sewage system

End customer: Government of Hong Kong

Mina Abdullah water pumping plant, Kuwait

Doubling Kuwait's supply of fresh water

• Extension and modernization of the country's biggest water pumping plant
• Doubles Kuwait's supply of fresh water to meet growing demand

ABB solution: Integrated control, communications, electrical and instrumentation solution for the entire pumping plant

End user: Ministry of Electricity and Water

Liwa water reserve, UAE

World's largest desalinated water reserve

• Underground storage of potable desalinated water for emergency use
• 26 million cubic meters of water stored in 315 wells up to 80 m below the Liwa Desert

ABB solution: SCADA solution to monitor and control the wells and pumping stations across three clusters, and integrated electrical solution for the entire project

End customer: TRANSCO

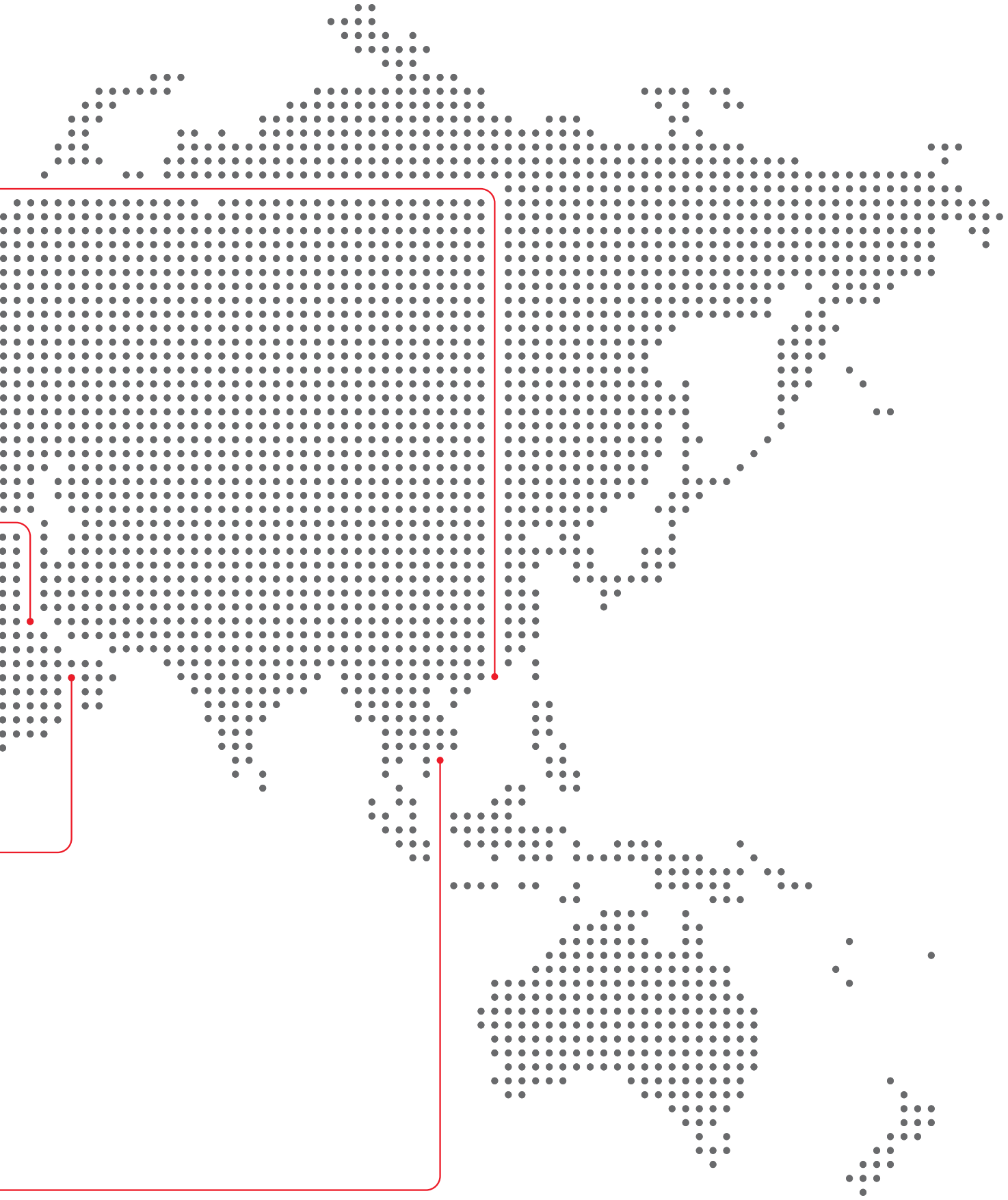
Ho Chi Minh City, Vietnam

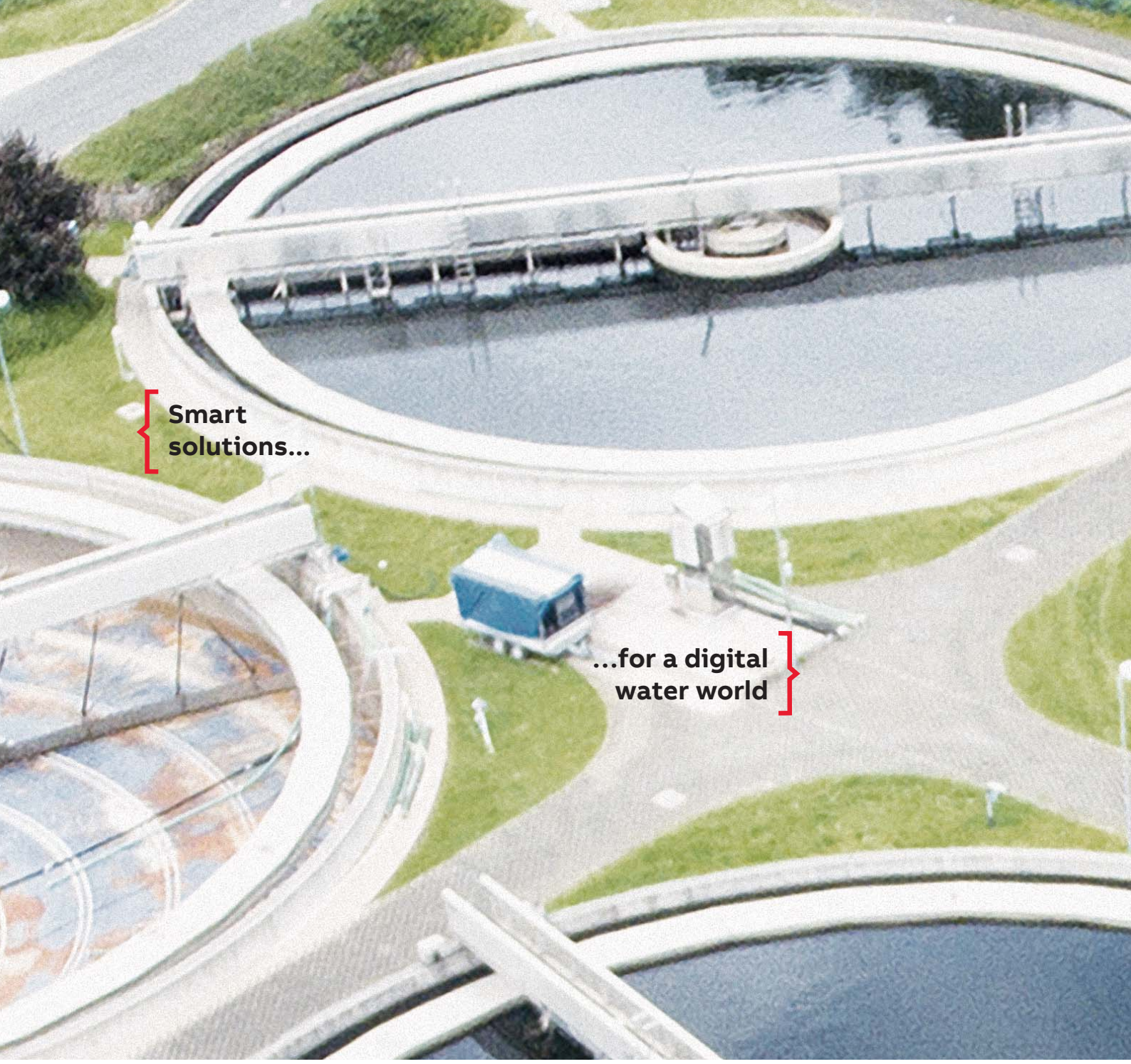
Booming city, leaking network

• Cut water network leakages from 30% to 10%
• Save 50 million m^3 in water and $10 million in costs per year

ABB solution: Real-time monitoring and control of the city's water distribution network, an advanced leakage detection and management system and water measurement products to increase efficiency, minimize non-revenue water, prevent disruptions and ensure everyone has access to clean water

End customer: Saigon Water Supply Corporation (SAWACO)





Let’s do digital!

Total automation for water

All across the water world – from treatment and distribution to transmission, pumping, irrigation, desalination and flood prevention – our total automation solutions help water companies reduce energy use, cut costs and keep their operations failsafe, cyber-secure and profitable. As the global leader in control systems and digitally enabled products, we help turn challenges into opportunities, while conserving a precious resource. Let’s write the future. Together. **abb.com**

ABB

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The EU General Data Protection Regulation (GDPR) is a significant piece of data privacy legislation which will came into force on May 25, 2018. It builds on existing data protection laws, strengthening the rights that individuals have over their personal data, and creating a single data protection approach. ABB is committed to complying with the GDPR and will be applying the necessary steps in all our customer and stakeholder interactions.

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