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Water Infrastructure

While there is consensus that the infrastructure improvements must be the top priority in projects like smart cities, their sustainability and efficiency in the long run are also a cause of concern. Express Water talks to experts and explores the reasons.

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A ‘Green’ Infrastructure In Our Menu

Water authorities around the world have been facing some serious backlash on how they manage their water infrastructure and plan their water resources for the future. Whether it is the problem of ‘Day Zero’ in Cape Town of South Africa, or closer to home in metropolitan cities of India like Mumbai, Delhi, and Chennai where water loss and stormwater management practices, at best, can be described only as reactive measures to the problems. In this issue, we have explored few trends as well as project case studies to understand the issues and share the best practices.

According to the findings of a new report which I recently read, the global market for water infrastructure repair technology (WIRT) market reached USD 68.8 billion in 2016. And it is expected to reach USD 92.3 billion by 2021 - with a compound annual growth rate (CAGR) of 6.1% through 2021. This shows that there are opportunities for project companies and water experts, and the need for exciting new technologies which must be cost-efficient in long-run.

While there is a consensus that the infrastructure improvements must be the top priority in plans of smart cities, their sustainability and efficiency, in the long run, are a cause for concern.

New trenchless pipe repair technologies and remote assessment & monitoring of networks are some of the areas where we still need to achieve a lot on the ground, specifically in the developing countries. Smart water meters will also help the water utilities a lot, for example in India, in creating a robust water supply network where not only the usage will be efficient but the billing and other relevant services will be more reliable for customers.

While there could be different views on the need of huge budgets, funds and resources to create and maintain a smart water infrastructure, we tend to forget that even those water utilities in India which have a cash reserve bigger than the budget of some states have failed to implement the solutions suggested by water experts. Our performance in managing the problems of urban floods, stormwater, leakage detection and water loss shows where we are. And that is only part of the problem. New and regular investments in our infrastructure are important, but we cannot hide behind the lack of funds and resources every time. We need to our basics right.

Our focus should also be on “overall asset management” instead of only a few areas highlighted in the projects or in media. Then we would be able to create a system where each component supports the others. And that, perhaps, is the key to achieving a green and sustainable water infrastructure.

In the Tech Focus section (on Water Safety & Security) this month, we have an interesting interview with Prof. András Szöllösi-Nagy. Read his views on ‘water governance’ and you will get a good insight into the topic. We have also done interviews with two industry stalwarts from India this month - Rajiv Mittal, MD & Group CEO of VA Tech WARAG and Ranjanath NK, MD of Grundfos Pumps India.

As always, I welcome editorial contributions on all the topics which you find significant for the water sector. Keep sharing...

"If you only design menus that are essentially junk or fast food, the whole infrastructure supports junk."
- Jamie Oliver

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LANXESS Appoints Neelanjan Banerjee as the New MD in India

Neelanjan Banerjee

Neelanjan Banerjee will be the new Country Representative and Managing Director for India effective September 1, 2018. He will assume these tasks in addition to his current function as head of the Advanced Industrial Intermediates business unit (BU AII) in India. Banerjee had joined LANXESS in 2006 as head of the former Basic Chemicals business unit and the Saligo business unit in India.

Manchester City Announces New Global Partnership with Xylem

The Premier League Champions, Manchester City has announced a global multi-year partnership with Xylem to become the Club’s Official Water Technology Partner. The partnership was announced at an event in Singapore, which was attended by Club legend, Joleon Lescott, during the Singapore International Water Week.

The Launch Event at Singapore International Water Week (l-r): Damian Willoughby, Senior VP of Partnership at City Football Group; Club Legend - Joleon Lescott; and Patrick Decker, President & CEO of Xylem

WABAG CSR Project to Benefit 250 Farmers and 350 Hectares of Farm Land

Mayur Sharma, India

Mayur Sharma, Financial Officer (CFO) of LANXESS India Private Limited since 2013, has been appointed as the new Country Representative and Country Director of LANXESS in the United Kingdom. Born in France, he has also held the position of Chief Financial Officer (CFO) of LANXESS India Private Limited since 2013.

“India is an important region for LANXESS that offers a lot of potential,” said Matthias Zachert, Chairman of the Board of Management at LANXESS. “The new regional organization under the leadership of Neelanjan Banerjee is specifically geared toward driving growth in India in the coming years.”

Sustainability Plan, Sokkan Odai Conservation Committee has been formed consisting of beneficiary farmers to take ownership of the community assets post project completion. This WABAG CSR project would benefit around 250 farmers and 350 ha. of farm land, supporting livestock rearing and livelihood enhancement of the local farming community. This project was conceived by the Agricultural Engineering Department of the Cuddalore Collectorate and implemented by WABAG with the support of Government, NGO and the Killai farmers.

Aquarius Spectrum and TaKaDu Announce Integration Partnership for Effective Water Management

EW Staff

EW Staff, Israel

The collaboration with Aquarius is an important step in our efforts to integrate TaKaDu’s Central Event Management solution with Aquarius’s automatic leak detection and monitoring system to detect, monitor, analyze and manage faulty pipes, hidden leaks and other anomalies in the water network. Integration between the two systems enables users to receive two independent indications about the same problem in the same area, one from TaKaDu and one from Aquarius. Using the centralized platform, operational teams can validate, track, prioritize and resolve events more easily, in coordination with other departments in the organization. The combined solution facilitates follow up action (for repairs, etc.) and provides management dashboards, actionable insights and detailed reports for strategic decisions and budget planning.

“The collaboration with Aquarius is an important step in our efforts to integrate TaKaDu with other alerting systems giving customers a one-stop-shop for effective water management,” said Udi Geismar, VP Customer Success, TaKaDu. “We’ve already successfully implemented a pilot at our joint customer Hagihon here in Israel, with substantial water savings.”
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INTERVIEW

WATER DIALOGUE

With Rajiv Mittal
Managing Director and Group CEO, VA Tech WABAG Ltd.

Rajiv Mittal is the Managing Director and Group CEO of VA Tech WABAG Limited - a pure play water technology Indian multinational. Her Excellency Ellen Johnson Sirleaf, President of Liberia and Nobel Laureate presented him the Distinction Award in 2014 for the Water Company of the Year at the Global Water Summit. The Indian Desalination Association has conferred ‘Lifetime Achievement Award’ on him in 2015. In 2017, he was ranked among the Top 3 Global Water Leaders, for the second time in a row, by WWi. Under his leadership, WABAG has been ranked among the top 10 global water companies and top 10 global desalination companies by GWI. During a recent conversation with Mayur Sharma at the head-office of WABAG in Chennai, he spoke candidly about his journey into the water sector, the status of WABAG’s current and upcoming projects and its ambitious future plans.
Please tell us about your journey into the water sector so far.

Mr. Mittal: I did my Chemical Engineering from the University of Mumbai and I was one of the few guys who didn’t want to go abroad for higher studies and wanted to start working straight away. One of the first companies on the campus that time was Dorr Oliver and I got selected and started my career. Fortunately for me, I was positioned in R&D and was given a project to develop a system for treating highly complex wastewater. That’s how my journey started, way back in 1981. Since then, there’s been no looking back! With my association in R&D, I was excited about developing viable technologies for Dorr Oliver which was globalized by them. At an initial stage, I also added key accounts to our clientele and made a beginning in India. I have been in the water industry for the last 35 years. In my formative years, I had grown from Dorr Oliver, winning and executing special projects, was selected by John Brown Engineering in the UK for their water treatment division and that’s how I spent about seven years in the UK.

Towards the end of my career in John Brown, I was approached by WABAG to work for them on international projects. WABAG was a German company at that time, owned by Deutsche Babcock and I moved to Germany, near Munich, took charge of international project development and also strategy. Towards the end of the first year, we had developed a strategy on how to penetrate the South East Asian market, and India turned out to be a bright spot to start WABAG’s business in South East Asia. I was given the responsibility in 1996 to return to India and manage the business for WABAG in India.

We started from scratch as nobody knew about WABAG in India at that point in time and we could develop a brand. Our first major breakthrough was getting the first project from an oil & gas major like Reliance in 1997, April. They were setting up their Jamnagar refinery which is one of the largest Greenfield refineries globally and we were lucky to get our first major account with an effluent treatment plant. This created ripples in the sector and we had made a mark overnight.

Post that, we experienced continued success with quite a few major clients in the industrial sector. We had devised a detailed strategy for India to diversify risks and optimize order intake based on macro-economic conditions. When the industrial business was slowing down and we had aspirations to grow, we moved into the municipal business for water and wastewater treatment. Our first success was with the Chennai Metro Water Supply and Sewerage Board – an order for the refurbishment of a sewage treatment plant. Because India, as a country, had a vision to be an economic superpower and infrastructure was a critical need with a huge gap in network and treatment infrastructure, the municipal market gained traction across tier 1 and 2 cities. This helped us, and due to the sheer size of the projects, we became more of a municipal company than an industrial one. But our initial industrial skill which we developed remained with the company and today we do almost 40 percent industrial and 60 percent municipal.

After Deutsche Babcock started having huge financial problems globally, especially in Germany and France where it was not doing so well, they wanted to sell their business in India. So, we were put in a fashion parade in front of a lot of potential buyers and we found immediately that the potential buyers would not fit in with our culture and the focus of our business. That was why we went ahead with the Management Buyout of the WABAG’s India business. The parent company continued not to do well and in the meantime, Siemens had acquired VA Tech in 2005. So, that time Siemens had their own water business and they couldn’t integrate WABAG into their water business. So, they decided to put WABAG on the block. So, we decided it’s a great opportunity to convert the Indian company into a global company. Though it was a much bigger business compared to our size in India, we could get our board’s approval to bid for it.

There was huge competition but we were successful and we could sign a deal with Siemens to buy their global water business towards the end of 2007 and that’s been the journey. Since then we have been growing not only in India but globally. Also, we helped WABAG get closure by completing the projects they couldn’t. We supported them. We then went in for a very successful listing in 2010. We were the first pure play water company to be listed on the Stock Exchange. Our stocks have done very well and they continue to be very attractive in the market. So, that’s been the journey so far and I think we are looking for further growing our business globally.

Already, we have 20 subsidiaries across the globe, we have 3 R&D Centers. And we continue our journey towards becoming one of the top three water companies globally.

Tell us about a few upcoming national and international projects of WABAG.

Mr. Mittal: Over the last few years, we have witnessed a subdued activity in India, since progressive policies were being drafted, and new schemes were coming up. We hope to see quick implementation in the months to come and it has already picked up under the flagship schemes of Namami Gange and AMRUT. Projects are progressing with new standards coming in. The government has given clarification on the new discharge standards. With this clarity on norms, it is an opportunity for all local bodies to get their projects on the line with a better idea on what the budgets would be. I feel the metropolitan cities across India such as Mumbai, Bangalore, and Delhi will be the first ones to come up with mega schemes. Tier-II cities will follow closely. And I think next 2-3 years will see a lot of wastewater treatment plants coming up for tendering.

We are also focused on the international market especially in Africa and Latin America, which we feel are goldmines of opportunity considering the gap in supply and demand infrastructure. This will also help boost exports from India with us being an Indian multinational. We also look at reinforcing our presence in the Middle East, South East Asia and Europe where we have had a historic presence.

On the industrial front, Oil and Gas is the growth driver where we have had huge success in the last couple of years with global giants for technologically intensive projects. Going forward, we look forward to capitalize on the potential in this sector further with more accounts added to our kitty.

How do you see the overall impact of GST on the Indian water sector?

Mr. Mittal: I think, when you bring about a change like GST, it’s a major change. In India, we had a very complex indirect taxation system with the Sales Tax, Service Tax...and all these excise duties. From that point of view, I think GST has more or less streamlined the taxation, made it simple for every company to comply with it. I think this will bring about better efficiency and better compliance. On a long-term, it will be beneficial to the industry. In short-term, yes there are going to be glitches like even in our contracts with some of these local bodies, they are still not able to change to GST because they don’t know how much is the impact of GST versus the earlier tax regime.

This discussion is definitely leading to delays and funding issues because if we cannot raise the bill, we cannot get funded and we cannot put the cash back into the operation. But this is short-term, and I think going forward in medium to long-term, it is definitely going to be beneficial and tax compliance will be definitely easier because it is going to eliminate multiple taxes and the compliance which was related to that.

The Municipal market had been stifled in the recent years by the slow economy and lack of funds. What is your take on the market going forward?

Mr. Mittal: Yes it’s true because especially wastewater takes the last priority for funding in infrastructure. It is always power, roads, drinking water which take precedence, so the industry has suffered from the lack of funds. But, I think, this allows the government to expedite projects, to put more money into Swachh Bharat, more money into AMRUT, and of course bringing in this new concept of hybrid annuity models, I think this will definitely pump in funding into these projects and bring greater prominence with global investors looking at the sector for good returns.

With the concept of reuse gaining traction, and policies being drafted on municipal - industrial partnerships for reuse, the way for a sustainable water management and...
revenue generation model is also evident. I’m very bullish going forward that we will see more projects coming up. Funding will not be an issue, because the government is committed to clean our water bodies and make sure we have a cleaner environment around us and 2018 will see a turn-around.

Talking about Municipal projects, tell us about your views about Namami Gange and smart cities project specifically. And how do you see the role of WABAG in these projects?

Mr. Mittal: I think both these are right in our domain - Namami Gange and Swachh Bharat. Yes, projects of this magnitude and with such a vision - it was slow to start with and both these projects took a long time to be streamlined and administratively get this moving. But I think that is behind us. Going forward in 2018 we will see a number of projects coming up in Swachh Bharat, Smart Cities and also in Namami Gange. And I see large projects coming up, especially in Namami Gange, they are going for an integrated city model, where the budget for each project will be at least INR 1500-2000 crores. In addition to such huge budgets, such integrated concepts will act as a role model and ensure a holistic approach to the vision for making Ganga nirmal and aviral, in line with the PM’s vision.

How much of WABAG’s focus is on research and development?

Mr. Mittal: A lot, a lot! As I said before, we are a technology company and we feel with the no. of markets in which we operate, with dynamic requirements, there is a need to innovate with an eye for feasible solutions. We don’t want to be a simple, general contractor where we won’t have a differentiator or a value proposition. We are also an asset-light company - so we also don’t believe in investing a lot of money into assets. Technology is our USP and we will continue to focus on that. I’m happy to say that today, we are spending more than 1 percent of our total turnover on R&D. Going forward in next few years, we will bring that number closer to 2 percent of our top line.

What would be the 3 most important issues in the water industry, within the next 5 years?

Mr. Mittal: To me, it will remain the administrative competency of the government to manage this kind of spending. Like we have seen in the past Namami Gange didn’t have any shortage of funds or for that matter Swachh Bharat or Smart Cities. But how to go about structuring that spending, that will remain as one of the important issues.

Second is how you execute the projects...and how do you control the projects so that the projects are completed on time so that the people get benefit from the money spent by the government. This has to be very well monitored. It is good to see that the government is giving that focus right from the top-right from the Prime Minister and Chief Ministers are getting into reviewing the project. That’s a healthy sign for India.

And thirdly, it’s getting all the approvals whether it’s land acquisition, whether it’s right of way, that kind of things. If they have a proper organization or agency where there is a single-window clearance, this will enhance completion of projects and will reduce the cost overruns due to delays in completion.

Are you satisfied with the Government policies for the water sector?

Mr. Mittal: I would say yes, reasonably satisfied with whatever I have seen in the last 3-4 years. The government has focussed on the right things. They have focussed on bringing the private sector into the funding because I believe the government is never short of money and the private sector is never short of technologies to handle any challenges. It was always the project management or administrative skills of a private sector which government was not able to use in the past. By making this a hybrid model and getting the private sectors’ money into this execution, I think the private sector will be more involved in administrating and managing these projects. It will also ensure completion because it’s their money and any delay will affect them.

Also, there was a policy of water being a resource rather than a liability. They said it’s an economic resource and they want to assign some value to water. Earlier in our country, it was taken more as a right rather than an obligation to pay. With payment mechanism coming in over the years, I’m sure there will be more money available for the sector to re-invest into building new infrastructure and maintaining the existing infrastructure. This way, going forward, we can see that our water sector will definitely have a greater focus.

Do you think there are still gaps between what water utilities need and what water current technologies are offering?

Mr. Mittal: No, as I said before I don’t see there is a technology gap in what is required. The private sector has done enough especially globally we have some half a dozen companies who have a solution for all problems, for all challenges. So, I firmly believe technologically there is no gap in meeting the standards. Yes, there can be always an improvement and that’s why we invest money in our R&D work which we are doing in Switzerland or in Austria or for that matter in Chennai along with some of the universities here. Our aim is always to see how we can make it more economical because something which may be very relevant in the advanced world may not be affordable for a developing country like India. So, I think most of our research and development goes into making technologies more affordable.

Please tell us about your International water market and current performance of WABAG geographically?

Mr. Mittal: Currently, WABAG is divided into 4 clusters. Firstly there is India cluster which not only includes India, the home market but also the neighboring countries and South East Asia.

The 2nd one is the Middle East and Africa cluster. We call it MEA. They focus on GCC countries and Africa - both North Africa and Sub Sahara Africa.

The 3rd one is our European cluster which is the business we acquired from Siemens.

And the last one which was started very recently, about a couple of years back, is the Latin American cluster which is a South American cluster where we already got a project last year in Ecuador and we are bidding for many more projects.

So, this is how we have strategically divided our geographical presence and aligned our vision. We already have a leading market share in India cluster. Our aim in the next two years is to improve our position in the Middle East and Africa cluster considering a huge potential in the region. We are, therefore strengthening both our capability and capacity with a new structure in place.

If we focus on the right talent and the technology, I think WABAG has a tremendous future in the Middle East and Africa. Europe is primarily a breeding ground for new technologies with not much growth happening in terms of project development since it is already developed barring potential in the industrial sec-
INTERVIEW

Torm for which our Czech and Romania offices have been actively working on.

WABAG’s Ujams wastewater treatment and water reuse project recently received a distinction award for industrial water project of the year. How do you see the future of water reuse?

Mr. Mittal: As I told you, WABAG is always associated with new technologies and advanced technologies. Ujams is one of those places where we have a cocktail of waste-water from tanneries, from breweries, from slaughter-houses etc. This is a complete mixture of very complex wastewater. We just didn’t go and execute this project. We did one year of piloting this project and that’s how we came up with the solution. Because once we give the commitment to our customers, we ensure that our solution works. This is also one of the projects in which, very rarely, we have invested our own money as a major investor. The project has been giving us good returns as well.

We have faith in the government of Namibia as well considering our earlier stint with the world-famous potable reuse project in Windhoek, Namibia. For the last 15 years, we have been operating and maintaining the plant. The capital city of Namibia, Windhoek, is getting this water for their potable purpose. We are very proud of this achievement.

Talking about the potential for reuse, I think it’s tremendous. Reuse today is giving an alternative source of water especially for industrial water projects. We have received a distinction award for it. I think going forward we will see more and more investments. In the pipeline, Chennai has plans for a 150 MLD plant right next to the existing 100 MLD Nemelli plant and a 400 MLD plant for which they applied for JICA loan. A lot more plants in the southern districts of Tuticorin, Ramanathapuram are planned as well. Chennai will be desalination capital of India where currently desalinated water caters to over 25% of the daily supply, and industries across India have been using desalination water for more than a decade.

Treated water is no longer a liability. The government is looking at this to be converted into an asset because every component of wastewater can help generate revenue. Whether the organics convert into power, the liquid can be reused or the nutrient-rich solids used as manure, it offers a comprehensive revenue generation model. This is what we call - Waste-to-Wealth, which will provide a sustainable model for the future.

After the successful performance of desalination projects in Chennai, Do you see a major shift in how desalination is viewed in India?

Mr. Mittal: Definitely, I think when we built this plant almost about 5 years back, everybody was talking about very handy coupled with a very good quality of water for potable purposes. For industrial or commercial use, you can reuse the water, but you need fresh water for potable purposes and that’s where I see its more use especially the coastal cities are planning for it and going for it.

There is a little bit of hesitation as far as the investment and decision making is concerned, but I think going forward we will see more and more investments. In the pipeline, Chennai has plans for a 150 MLD plant right next to the existing 100 MLD Nemelli plant and a 400 MLD plant for which they applied for JICA loan. A lot more plants in the southern districts of Tuticorin, Ramanathapuram are planned as well. Chennai will be desalination capital of India where currently desalinated water caters to over 25% of the daily supply, and industries across India have been using desalination water for more than a decade.

I will end with the CSR activities of WABAG, what is the philosophy behind it?

Mr. Mittal: See there are two philosophies behind it. First let me say that our business itself is a CSR because what we are doing we are producing clean, safe water. And we are treating the wastewater and preventing pollution around us and preserving the environment around us. To me, our business itself qualifies for CSR. Coming to the CSR, every corporate should invest 2% of their profit into CSR. We were already into CSR because we strongly believe what we are today is contributed by the society in growing us, in making us what we are today. So, part of that should go back to the society as an investment to improve the quality of their life. That has been the philosophy for us and I think with this new act we have more money at our disposal.

Our aim is always to be in the water part in CSR whether it is providing safe drinking water to villages, to schools, to other organizations who cannot afford to have safe drinking water. So that’s the first point.

The second point is that if we can help the poor, the marginal farmers, who do not have water for irrigation and that is their livelihood. If they don’t have water what will they grow and then they migrate to the city and that itself is a problem. So, if you want them to stay in their own villages and be able to generate revenue for their family, you need to bring water to them. We are getting into a lot of watershed programmes in ensuring that there is water for them. We are digging wells for them, we are desilting the existing wells and we are going for drip irrigation to conserve water. So, these are the things which we are doing.

Lastly, there are a lot of water bodies, even in our cities and around us which get polluted and misused. We have been adopting some of these water bodies and ensuring that they are maintained and become a good source of recharging the groundwater tabulae. Otherwise, especially coastal cities will have a lot of seawater ingress into it. So, we are spending a lot of technologies and our efforts in...
Grundfos India completed its 20 years in India earlier this year. How will you describe your journey for our readers...including the highs and lows?

Mr. Ranganath: We started the company in 1998 with only about eight sales employees, out of which four were in the Chennai office, three in Mumbai and one in Bangalore.

Grundfos India is a 100% subsidiary of Grundfos Denmark - a global leader in advanced pump solutions and a trendsetter in water technology. It is one of the world’s leading pump manufacturers with an annual production of more than 16 million pump units. Ranganath NK is the Managing Director of the company. He joined Grundfos in February 1998 and established Grundfos India in March 1998. Ranganath has been involved in technology transfer to India from other countries including Denmark. He is currently the Co-chair of the CII National Committee on Water and the Southern Regional Chair for the Committee on Ease-of-Doing-Business. He discusses the journey of Grundfos India and its future plans with Mayur Sharma...
rate since inception has been 20%, which (in a market that is fragmented and saturated with pump manufacturers) is a satisfying growth.

The major issue we face is the disregard amongst Indian manufacturers for intellectual property rights and the blatant copying of our products. Some of these products are sold at prices lower than our material cost which means some corners are being cut. But the good thing is that majority of our customers are repeat buyers, some of them returning after trying out the copies.

In the initial years, the impression was that Grundfos was a little behind, whereas other major pump players were already in India. So, was there any apprehension? What was the approach then?

Mr. Ranganath: That is not true. Except for KSB (1960) no major player was present in India until we entered in 1998. There were apprehensions until we decided to enter as India was a protected market and pump manufacturing was reserved for the small-scale sector. We, at Grundfos, had immense faith and confidence in our brand’s quality and innovation and so we decided to set up in India, perhaps the toughest market even today for pumps. During our entry into the Indian market, we saw that there was a large gap in what industries required and what was being delivered. We saw this as a big opportunity and decided that our approach must be to play to our strength which was to provide innovative solutions with unmatched quality and reliability, something that the competition could not provide. Matching global expertise and local wisdom (understanding market needs and dynamics) helped in sustaining our growth. It made business sense. Fragmented and saturated pumps even at double the initial price as the payback due to the higher efficiency was less than 12 months in most cases. Even today we look to identify pumping issues faced in India and look at them as opportunities to find solutions that in turn help us understand how better to cater to the growing and ever-changing demands of India. This helps to accelerate the learning curve, be ready with reliable products that can address issues and always be one step ahead.

Since then we have come a long way. Today we can boast of intelligent, innovative solutions like Grundfos iSolutions, Digital dosing pumps, Smart Solarz - a made in India solar pump.

Was it a difficult decision to start production facilities in India or was that something that you thought from the very beginning?

Mr. Ranganath: No, it was not a difficult decision as we knew that if we need to grow in India we need to make in India, whatever we can. But getting the right approvals in time in 1998 – 99 was not easy in spite of the fact that the country had started the liberalization process in the early nineties. Anticipating growth in volumes due to the change in policies and to keep in mind that we needed to be competitive in cost especially in a market such as India, starting a product-facility was always on the cards.

In terms of the stages of evolution right now, which are the segments where you see more acceptance of various product ranges of Grundfos India?

Mr. Ranganath: Solutions that run on renewable energy are gaining acceptance in the market. Our solar powered pumps are seeing a growth in demand as both the government as well as end users lay more emphasis on conserving energy and reducing their carbon footprint. Energy efficient products with embedded intelligence are seeing a rising demand. The cost to benefit ratio is now more attractive than before. We believe that with upcoming regulations on energy consumption by buildings, the demand for such solutions will rise even more.

Another segment where we have seen a huge jump is the drinking water segment. Lack of access to clean drinking water has been a problem for many years, but today the awareness of this issue has gone up multifold. Secondly, the rapid depletion of water sources has raised an alarm in the public as well as administration. Many cities/ countries are now looking for solutions that can provide them with access to clean drinking water. Therefore, our solutions that address the issues of water conservation, water recovery and efficient water distribution as now seeing a spurt in growth.

Geographically, which are the markets that you see growing faster in India and which are the stronger markets for Grundfos?

Mr. Ranganath: The market growth varies from year to year, segment to segment and region to region. In 2018 we see a spurt in demand in the building industry which was a bit dull in 2017. The south has always been a big market for us perhaps since we are based in the south. We have opened another factory in Ahmedabad and with a bit of focus on the west, we can now see a spurt of growth in the west. Last year it was the east which had the highest growth percentage though the overall sales are not that high. Grundfos is very strong in the real estate sector and industry, especially in water treatment. We also are strong in the automotive sector where reliability is a vital factor.

Recently you had said that... “The potential in India is immense and by 2050 India will be the third biggest economy after China and the USA. And Grundfos needs to be a part of this growth story of India.” Please elaborate on that.

Mr. Ranganath: It is estimated that the world economy could more than double in size by 2050, far outstripping population growth, due to continued technology-driven productivity improvements, and emerging markets like India could grow around twice as fast as advanced economies. India will perhaps by 2050 be the third largest centrifugal pump market in the world. It is this potential market that Grundfos is aiming to be a part of. Our products are one of the best and most advanced in the world. Our solutions even if more expensive, not only deliver the ‘Return on Investment’ to the customer but also help them maximize resource conservation. With our capabilities and the ability to come up with innovative solutions, we are sure that our contribution to the India growth story will be significant. We don’t aim to be the biggest company in India in terms of turnover but we certainly aim to be the most trusted company in India which adds value to customers.

Innovation has been a buzzword in the market for a long time now. How does Grundfos see it? What are some of the recent innovations Grundfos is really proud of?

Mr. Ranganath: Innovation is the key driving force at Grundfos Pumps. We are committed towards the development of new and innovative solutions that are future ready. This is the reason why we annually invest up to 4% of our profits in R&D, higher than any other pump manufacturer in the market.

One of our very successful solutions in this domain is the Grundfos iSOLUTIONS. With its state-of-the-art pump intelligence, it ensures that all the pumps, drives, control & protection units, measurement and communication units all work together as one complete, energy efficient and connected system which can adapt itself to work efficiently based on the usage patterns.

Under the iSolutions range, we have Grundfos’ SMART Digital XL DDA and DDE dosing pumps that can dose very accurately, thereby saving expensive solutions and chemicals in industries like food, pharma etc. It also improves the quality of the end product due to the consistency of dosing.

SMART Digital XL DDA and DDE are all based on tried and tested Digital Dosing™ technology from Grundfos. They offer powerful, variable-speed motors, a universal power supply, and diaphragms that meets the most demanding requirements for chemical resistance and durability.

How do you approach ‘sustainability’?

Mr. Ranganath: Our goal has always been to be capable to contribute towards the making of a cleaner and greener world. Due to this, we ensure that all our products are energy efficient not just when they run but also when they are made.

Around 10% of the world’s energy is consumed by pumps. If these pumps are replaced with energy efficient pumps (like Grundfos), we can save around 4-5% of this energy. Also, most pumps waste energy due to incorrect sizing, lack of intelligent control, operation at an inefficient duty point or outdated technology. A Grundfos Pump Audit evaluates pump efficiency and the potential for saving energy at a site. A Pump Audit results in an overview of pump performance and suggestions for improvement. Pump audits have produced tangible results for all types of customers. Many types of industries and water supply companies have cut their energy consumption by 40-60%. Their pumps pay for themselves in a short time. From 2011 till date, Grundfos India has conducted 2304 pump audits on 16,741 pumps.
This has resulted in identifying power savings of 43,619 KW which is equivalent to reductions of around 1,88,384 tons/year of CO2 emissions.

Grundfos India also contributes towards energy and water conservation by reducing its own impact on the environment. Its headquarters in Chennai is India’s first gold-rated green building (LEED certification by USGBC in 2005) and is energy efficient with 100% recycling of the sewage, rainwater harvesting and with solar collectors and photovoltaics. Grundfos India’s factory also received the gold certification in 2011 from the Indian Green Building Council (IGBC). In August 2013, the Grundfos office building was elevated to a LEED EB Platinum certification.

We have an internal target of not using more water or emitting more CO2 than we did in 2008 in spite of an increase in production.

Among our initiatives that help us reduce our environmental footprint are recycling the process water used for testing the pumps, recycling 100% of the sewage and harvesting rainwater not just for our own use but also to recharge the aquifers in the area. Pallets and frames made of recyclable wood used in Grundfos India are sent to suppliers for packing the components to avoid deforestation. Through this initiative, we have saved around 6264 kilograms of wood with the cost reduction of 1.2 M INR. We have installed a Rooftop Solar Panel of 146 KW to reduce the cost of energy. In the year 2017, we have started an initiative called RECYCLE Food Waste. By recycling the food waste with the help of a compost conversion machine, there was zero wastage and the manure does not have to be bought from external sources for the garden.

Grundfos India is also responsible for the business in Bangladesh, Bhutan, Maldives, and Nepal. Give us the status update of these markets as well.

Mr. Ranganath: These are small markets compared to India but important markets for us. The approach to each country is different and is based on the local needs. There are some products made in India by us that are sold there but there are also products made in other countries that we sell. The focus in all these countries except Bangladesh is more on the building sector. Bangladesh has a mixture of commercial buildings, industry and water utilities.

Grundfos India has launched ‘SmArtServ’ - a mobile app to enhance its customer service. What is the philosophy behind overall Grundfos Service?

Mr. Ranganath: Our SmArtServ app was launched with the objective of reducing the reaction time and providing service support for any Grundfos product. Through this app, one can locate the nearest service provider, fill in the details of the complaint/request, attach a picture of the pump/system and raise a service request and track the progress of the service request.

The SmArtServ app also enables one to also escalate if the customer is not satisfied with the response, archive service reports, and quotation for spare parts.

SmArtServ is available on iOS, Android, and Windows. This user-friendly mobile app can also be installed on a desktop computer.

Do you think that the new reforms or initiatives announced by the government will help?

Mr. Ranganath: We believe that these reforms/initiatives are necessary for the development of the nation. All these initiatives are in the nascent stage and we, wherever possible, are in touch with the stakeholders to evolve the right approach and solutions.

Cities are smart when they can cater adequately to its inhabitants with minimum impact to the environment. Clean air, water, transportation etc are vital and at Grundfos, we have many solutions for sustainable water for smart cities.

For example, Grundfos’ Demand Driven Distribution (DDD) is a unique pumping solution where the supply of water is programmed as per the demand at the consumer’s end. This system can automatically monitor grid use patterns with remote sensors and adjust the water pressure accordingly. This reduces both water and electricity consumption by up to 20%, and water pipes will last longer because they are less likely to crack.

Another interesting offering from Grundfos is the Grundfos’ Remote Management - an internet-based, secure and technologically advanced system for monitoring and managing pump installations in commercial buildings, water supply networks, wastewater plants, etc. Through this system, pumps in an entire commercial building complex, or water, and wastewater treatment plants can be remotely monitored from a control room with minimal human intervention.

Grundfos has won the award for ‘India’s Best Company of the Year 2017’, for its current year market standing, innovation, leadership, governance, and CSR initiatives. How satisfactory is that?

Mr. Ranganath: It’s a mix of understanding local needs and challenges, developing focused products via engineering and R&D, developing long-lasting relationships with customers while being sensitive of our social responsibility as a corporate. While we play hard in the market, we also want to give back to the society and environment that supports our growth. Maintaining this balance is very important for us. We believe in leaving behind a more energized planet then the one we inherited and these awards are good to remind us to tread this chosen path.

Do you look at Grundfos India contributing in terms of being engineering, manufacturing, and innovation hub as well for Grundfos Denmark in near future?

Mr. Ranganath: Possibilities do exist and we are exploring the options.

In a lot of the projects and applications, energy is one of the key drivers. People are now looking more at the operating costs and the lifetime costs. What is Grundfos’ approach there?

Mr. Ranganath: As mentioned earlier, around 10% of the world’s energy is consumed by pumps. Also, almost 9 out of 10 pumps are inefficient. Therefore, if these pumps are replaced with energy efficient pumps (like Grundfos), we can save around 4-5% of this energy. Grundfos has always focused on providing solutions that are energy efficient. Energy efficiency is a major USP of Grundfos’ products. It is in our DNA. We develop our solutions in such a way that they require significantly less maintenance and repair than some of the other products in the market. Many a time people end up buying products that have a low initial cost but without any regard to the costs of power consumption and maintenance over the life of the product. However, what they fail to understand is almost 85% of the lifecycle cost is power/energy costs and inefficient pumps end up consuming more energy thus incurring recurring costs.

Studies have shown that in the lifecycle of a pump the initial cost is only 5% while the power cost is 85% and the remaining 10% accounts for the maintenance costs. In such a situation, it is better to invest in efficient products. Though it might be expensive, the extra cost is easily recovered in less than three years in almost all cases and many a time within a year.

All our pumps and motors need to be energy efficient. We have introduced super-efficient IE5 motors with our pumps in the Indian market which is just now moving to IE2.

Overall, what is your view on the macro-economic situation in India in the next 12-24 months?

Mr. Ranganath: The last six months have seen a very good growth for most sectors of industry. We are positive about the continuation of market growth in the long run. But in the short/medium term, there are dark clouds on the horizon. With the impending trade wars, the rising oil prices and the strengthening US dollar, the possibility of high inflation cannot be ignored. Couple this with the impending election in 2019, we can be in for a lot of headwinds. Hope that the quick solutions are found for these macro issues and going forward, the government will continue their efforts in sustaining this economic momentum without hurting the economy by bringing in populist initiatives.

Finally, how do you see Grundfos getting positioned in the Indian market in the next 12-24 months?

Mr. Ranganath: As I said before, not as the biggest but as the most trusted and admired company.
It’s Amazing to See the Long-Lasting Impact of Desalination on a Country!

Gilad Cohen is the CEO of IDE Americas. Gilad joined IDE in 2009 as Corporate Business Development Manager, responsible for investment evaluations and M&A activity, as well as the development of new business platforms in target markets. In January 2017, he was appointed CEO of IDE Americas, managing sales, marketing and business development activities for North and Central America. Here he discusses the status of desalination market and shares his views about some interesting technologies, trade practices and IDE’s strategies for the same, with Mayur Sharma.

How can desalination best mitigate and address the high energy, cost, and toxic effluent from membrane problems? And what is the best way to reduce the environmental impact of polluted membranes after use?

Mr. Cohen: Desalination can address the high energy usage by finding ways to reuse energy during the desalination process. In addition to the reverse osmosis membranes and pressure vessels, the Carlsbad Desalination Plant houses 144 state-of-the-art energy recovery devices produced by Energy Recovery, Inc. The energy recovery devices work by capturing the hydraulic energy created by the high pressure reject stream of seawater produced during the reverse osmosis processes and transfers it into incoming seawater, without consuming any electrical power themselves. These devices save the plant an estimated 146 million kilowatt-hours of energy per year; reducing carbon emissions by 42,000 metric tons annually - roughly equivalent to the annual greenhouse gas emissions from 9,000 passenger vehicles.

In the Sorek Desalination Plant, large diameter (16-inch) membranes are incorporated in a vertical array that includes the use of a minimal number of independent trains fed by both feed pumping centers. The behavior of the 16-inch membrane element is identical to that of the 8” membrane, resulting in identical salt rejection performance and a correspondingly four times larger flow rate at the same feed pressure and operation conditions. This approach allows a significant reduction in membrane handling for maintenance purposes. In addition, due to the larger volumes of feed water, there is a lower tendency for membrane fouling and polarization in the second stage. If required, the same configuration can produce larger quantities of permeate by operating at the high production regime for longer periods and increasing the flux through the membrane elements within the limits of manufacturer recommendations.

To reduce the environmental impact of chemicals in the desalination process, IDE has developed IDE PROGREEN™ - the first Reverse Osmosis (RO) technology designed to produce clean water from standard seawater, without the use of chemicals. IDE PROGREEN™ is based on two concepts: Direct Osmosis Cleaning (DOC) and Contact Media Coagulation. DOC is a patented process that keeps the membranes constantly clean, without the use of the chemicals normally required for membrane cleaning. By equalizing external pressures for a short time, DOC allows the osmosis process to flush the membranes with permeate water, keeping them clean while eliminating the need for chemicals in the RO process.
This results in reduced energy consumption, as less maintenance is required and the need to neutralize and dispose of harsh chemicals is eliminated.

The IDE PROGREEN™ biological pretreatment process is a combination of a particulate bio-flocculation unit and a set of multimedia filters. The system removes suspended solids and organic matter from the feed seawater. Any community can support IDE PROGREEN™ as the water produced can be used for numerous purposes, including potable water for municipalities and resorts, agricultural purposes and Boiler Feed Water for industrial usage.

All of these are the efforts made by IDE in order to reduce environmental concerns by optimizing energy consumption in the process, reducing the chemicals footprint, and extending the usage lifetime of the membranes used in IDE’s desalination plants.

In the desalination market, the latest studies and advances are aimed at cost savings, both in energy consumption and in the final cost of desalinated water. In addition to the incorporation of renewable energies, what other technologies would contribute to further reduce these costs?

Mr. Cohen: In desalination, a reduction in chemical usage in the desalination process can reduce operational costs by an astounding 10 percent for the customer. IDE PROGREEN™ is a modular “plant in a box” and the capacity of the fully customizable modular units ranges from 500 m³/day to 20,000 m³/day. The plant delivers affordable clean water with reduced energy consumption and can also be easily transported, eliminating the need to invest in expensive infrastructures, thus increasing ROI.

In 2014, IDE installed its first IDE PROGREEN™ plant, which has been operating successfully for more than two years on Hayman Island in Australia’s Great Barrier Reef. The plant delivers 1,000 m³/day of fresh water and replaces three thermal desalination systems that supplied water to the island for 27 years. The combination of biological pre-treatment and the natural direct osmotic cleaning proves that an RO system can produce stable and high-quality permeate without the use of any chemicals. Moreover, operational data demonstrates that operating at higher than common fluxes provides additional cost savings, reducing capital and operation costs through the total elimination of chemicals and lower energy consumption due to decreased fouling developed on the membranes.

One major challenge facing Brackish Water Reverse Osmosis (BWRO) plants today is increasing the system recovery to improve its economics and better address issues related to brine disposal. As opposed to SWRO where the recovery is mostly limited by the brine osmotic pressure, BWRO treatment plant recovery is limited by the water chemistry which prevents the systems from maximizing its potential, due to the risk of scaling. IDE provides solutions which will allow these systems to realize its potential and maximize recovery to astonishing levels of up to 98 percent. These technological developments provide an unprecedented

Aerial View of the Sorek Desalination Plant, Israel

Osmosis (BWRO) plants today is increasing the system recovery to improve its economics and better address issues related to brine disposal. As opposed to SWRO where the recovery is mostly limited by the brine osmotic pressure, BWRO treatment plant recovery is limited by the water chemistry which prevents the systems from maximizing its potential, due to the risk of scaling. IDE provides solutions which will allow these systems to realize its potential and maximize recovery to astonishing levels of up to 98 percent. These technological developments provide an unprecedented
The future of seawater desalination in India is prolific. Our partnership with Reliance has created the first Reverse Osmosis plant in Gujarat. IDE has an office in Noida, as part of IDE's engineering base as well as sales, marketing, and business development.

IDE's MVC plants are being customized for economic performance over the longer-term, delivering lower operation and maintenance costs, with eco-friendly solution which recycles waste steam to generate electricity, and compact size for reduced footprint and capex. IDE's MVC evaporators are also utilized in the oil and gas industry to treat oil and gas water (Produced Water) to a high level of purity.

How long have you worked in the field of seawater desalination? Could you tell us something about your own experience in this field?

Mr. Cohen: I have worked in seawater desalination for almost nine years. Over the years, it’s been amazing to see the long-lasting impact desalination can have on a country. Take Israel for example. When faced with the worst drought in 900 years, the Israeli government began the implementation of a long-term, large-scale SWRO desalination program. This led to the creation of a wave of five large desalination plants - three of which were designed and constructed by IDE. Today, IDE's Sorek, Ashkelon and Hadera desalination plants now supply 70 percent of Israel's drinking water.

What is the state of your company's current and upcoming seawater desalination programs and projects? Can you give us some facts and figures?

Mr. Cohen: IDE has more than 400 desalination plants in 40 countries across the globe including India, China, U.S., Chile, and Australia. Our notable membrane desalination projects include:

- **Sorek Desalination Plant (Israel)**
  - It's the largest and most advanced SWRO plant worldwide, with a capacity of reverse osmosis desalination solutions are ideally suited to growth situations and start with capacities of 500 m³/day, the systems can very easily be expanded to capacities in excess of 30,000 m³/day.

**Please shed some light on the product and services portfolio of your company related to seawater desalination.**

Mr. Cohen: IDE offers membrane desalination as well as thermal desalination solutions to provide a reliable, sustainable and economical solution for municipalities and industries.

**Membrane Desalination**

- Municipalities, power, oil & gas, mining, resorts and many other industries need clean desalinated water for a variety of domestic, industrial and agricultural uses. Key benefits of IDE's membrane desalination plants include:
  - Customized Pre-treatment systems: These systems assure maximum efficiency and lifespan of plants to deliver improved cost efficiencies and ROI.
  - Advanced membranes: IDE's membranes increase capacity while minimizing investment.
  - Consistent quality standards: IDE's small to large scale plants produce high-quality drinking and industrial water from both seawater and brackish water while meeting strict health and safety standards.
  - IDE's modular Sea/Brackish Water Reverse Osmosis (SWRO/BWRO) units are ideal if a customer needs a desalination solution that is flexible, able to grow and completely self-contained.
  - IDE utilizes the most recent RO technologies for small to mid-size desalination projects.

- These are designed to provide high performance and reliability, together with ease of operation and low energy consumption. IDE's modular reverse osmosis desalination solutions are ideally suited to growth situations and start with capacities of 500 m³/day, the systems can very easily be expanded to capacities in excess of 30,000 m³/day.

**Thermal Desalination**

- Refineries, power plants, and other industries need high purity water so thermal desalination is ideal. The thermal desalination process uses energy to evaporate water and subsequently condense it again. When there is waste heat or sufficient electricity available, as is often the case with refineries and power plants, thermal desalination is an efficient and viable solution.

IDE's low-temperature thermal distillation units are capable of producing both drinking and boiler feed water from seawater. They are available in two versions differentiated by the method used for the supply of energy:

- **Multi-Effect Distillation (MED)** - A Low-Pressure Steam Process: Its underlying concept is a multi-effect process in which a spray of seawater is repeatedly evaporated and then condensed, with each effect at a lower temperature and pressure. This highly efficient process multiplies the quantity of pure water that can be produced using a given quantity of energy, resulting in a significant reduction in cost. Key benefits of IDE's MED plants are safe and reliable continuous operation, lower operation and maintenance costs, and eco-friendly solutions to minimize the impact on the environment.

- **Mechanical Vapour Compression (MVC)** - A Proprietary Electrically Driven Mechanical Compressor: IDE's self-contained MVC unit is a reliable, cost-effective desalination solution when electricity is the only source of power. MVC plants use waste steam to generate electricity so operational costs are reduced and less steam is released into the environment. Key benefits of IDE's MVC units are being customized for economic performance over the longer-term, delivering lower operation and maintenance costs, with eco-friendly solution which recycles waste steam to generate electricity, and compact size for reduced footprint and capex. IDE's MVC evaporators are also utilized in the oil and gas industry to treat oil and gas water (Produced Water) to a high level of purity.

IDE's MVC power consumption is 30 percent lower compared to other evaporators in the market.
CARLSBAD DESALINATION PLANT (U.S.)

It is the largest seawater desalination plant in the Western Hemisphere, with a capacity of 204,000 m³/day. It is also the winner of ‘Desalination Plant of the Year 2016’ and ‘Desalination Deal of the Year 2013’ from Global Water Intelligence. It is named as Membrane Facility of the Year at MembraneTech Conference in 2017.

SANTA BARBARA DESALINATION PLANT (U.S.)

The plant was recommenced after being mothballed for 25 years. It was reopened in 2017 and expected to produce 3 million gallons of water per day to meet 30 percent of city’s demand. It uses 40 percent less energy than the original design, greatly reducing its electricity demand and carbon footprint, by using high-efficiency pumps, motors, and improved filter technology.

Our notable thermal desalination projects include:

GUJARAT/RELIANCE (INDIA)

This is the largest desalination plant in India, with a capacity of 160,000 m³/day, and will be increased to 252,000 m³/day. It is having a continuous and successful operation for more than a decade, with low energy consumption. IDE’s Expansion of the Reliance Jamnagar Refinery was shortlisted as ‘Industrial Desalination Plant of the Year’ by GWI.

TIANJIN (CHINA)

This is the largest desalination plant in China, with a capacity of 200,000 m³/day. Its technology enables recycling the waste saline brine output, for processing into salt. The unique technology eliminates dependence on external freshwater resources. It is also shortlist-ed for ‘Desalination Plant of the Year 2011’ from Global Water Intelligence.

What were the achievements of your company in 2017/18? How has the company grown?

Mr. Cohen: In 2017, IDE was involved with the expansion of the world’s largest refinery, the Reliance Jamnagar Refinery in India, to include two new desalination plants. The expansion includes three 24,000m³/d plants using thermal desalination technology - IDE’s Multi-Effect-Distillation (MED) - as well as one 168,000m³/d Seawater Reverse Osmosis (SWRO) plant. Reliance’s expansion to include a petrochemical complex will continue to provide high-quality boiler feed water, cooling water and potable water and brings the refinery’s total capacity to 240,000 m³/d.

This year, IDE completed the installation and commissioning of two MVC evaporators in an oilfield near the city of Karamay, in the Xinjiang region in western China. It has a total production of 5,000 m³ distillate/day. The MVC evaporators treat produced water from Steam-assisted Gravity Drainage (SAGD) sites nearby. The produced water is treated before reaching the evaporator. This pre-treatment includes oil and Total Suspended Solids (TSS) removal and softening (i.e. removal of hardness, silica, and metals).

This year, IDE is setting up two new wastewater reuse demo facilities in California which will open later this year. The Central Coast Blue Advanced Water Purification Demo Facility, in partnership with the City of Pismo Beach, will have a capacity of 58,000 gallons of water per day. It will allow IDE to demonstrate and test its proprietary new recycled water process, Ecological Reuse (Eco-Reuse) which is designed to optimize performance while minimizing costs. It uses a proprietary preventative maintenance approach without the use of chloramine and hence avoiding the formation of Nitrosodimethylamine (NDMA) - an organic contaminant suspected as carcinogenic.

The Regional Recycled Water Advanced Purification Centre Demo Facility, in partnership with the Metropolitan Water District of Southern California and the Sanitation Districts of Los Angeles County, will have a capacity of 500,000 gallons of water per day. IDE’s new RO process for wastewater reuse will be integrated into a novel process using membrane bioreactors (MBR) as a pre-treatment to the RO to remove tiny particles, biodegradable pollutants, and nitrogen compounds. The RO system will then be used to remove suspended and dissolved components, such as bacteria, viruses, pharmacueticals, and salts, eliminating more than 90 percent of all impurities.

What are some of the major orders won by your company in the last two years?

In 2017, IDE was awarded by Formosa Petrochemical Corporation (FPCC), engaged in the refining and distribution of oil products, to design, build and supervise operations at its SWRO desalination plant. The desalination plant will be located at the Mai-Liao Power Corporation in Yunlin County, Taiwan and have a capacity of 105,000 m³/day.

IDE was also commissioned by OTEKO, a diversified holding company involved in transport services for the Russian Federation, CIS countries, to deliver reverse osmosis systems to OTEKO’S desalination plant. The IDE PROGREEN™ reverse osmosis desalination units will produce 11,000 m³ of drinking-quality water per day in the coal terminal to spray the coal piles and eliminate the spread of coal dust by the wind.

Could you tell us about some of the most interesting projects seawater desalination that you have participated in? What conditions have you encountered?

One of the most interesting seawater desalination IDE has ever built was in Cape Preston, Australia. It is the first pre-assembled large-scale desalination plant. The plant has a capacity of 140,000 m³/day and provides clean water to CITIC Pacific Mining’s Sino Iron project. The greatest hurdle IDE faced with design and construction was the remote location of the project. Therefore, a tactical decision was made to build the plant in China and assemble it in Australia.

Along with the assembly challenges, IDE had to overcome environmental obstacles with the plant. The feed seawater conditions at Cape Preston are difficult, including very high levels of Total Suspended Solids (TSS), high levels of organics, and large numbers of jellyfish, which create challenging requirements of the pre-treatment system. There are also significant daily tidal variations and conflicting currents that reverse seawater temperature and characteristics every six months. Therefore, IDE had to ensure that the plant’s pre-treatment technology could address these unusual conditions arising from the nearby marsh areas and changing daily tide differentials.

How are your seawater desalination projects financed, and structured?

Seawater desalination projects are financed in various ways, including:

Build-Operate-Transfer (BOT): With this model, IDE receives a concession from the private or public sector to finance, design, construct, own, and operate a facility, usually in the concession contract. This is one of our most common financing structures, and it falls under the definition of Public-Private Partnerships (PPP): This is a contractual agreement between IDE and a public agency (federal, state or local).

Engineering-Procurement-Construction (EPC): With this model, IDE is responsible for all the activities from design, procurement, construction, to commissioning and handover of the project to the end-user or owner.

Operation and Maintenance Services (O&M Services): based on IDE’s extensive expertise in the field IDE offer operation and maintenance services to existing or new desalination plants.

What is the future of seawater desalination in India, in your opinion?

Mr. Cohen: The future of seawater desalination in India is prolific. While IDE has seen success with desalination for industrial usage, there is also the opportunity for municipal water usage. With the right financing model, a seawater desalination project may not necessarily require high upfront costs. Our partnership with Reliance has created the first reverse osmosis plant in Gujarat, India. IDE has an office in Noida, Uttar Pradesh, in India as part of IDE’s engineering base as well as sales, marketing, and business development.

Finally, what are your growth and expansion plans for the next 5 years?

Mr. Cohen: IDE continues to see steady growth in our business and strong regional presence around the world. We are working hard to continue helping to change the world and help our customers overcome the increased scarcity and instability in water resources.

Our goal is to continue offering water solutions, from desalination, wastewater reuse and industrial water solutions that would be sustainable, affordable and environmentally responsible.
While there is consensus that the infrastructure improvements must be the top priority in projects like smart cities, their sustainability and efficiency in the long run are a cause of concern. Express Water talks to experts and explores the reasons...
Adequate Water Infrastructure Must Keep Up with the Urban Development!

Bentley Systems provides engineers, architects, geospatial professionals, constructors, and owner-operators with comprehensive software solutions for advancing the infrastructure. Mayur Sharma recently interacted with the Bentley team (Amit Trehan - Director - Corporate Communications, Frank Braunschweig - Senior Project Manager, Perrine Parrod - Senior Product Marketing Manager Water, Slavco Velickov - Global Water Industry Sales Director, and Alan Lamont - VP Digital Advancement Academies) on various topics ranging from the growth of water sector - to the state of infrastructure and the role of new software-based platforms in their sustainability.

How do you see the “Indian Water & Wastewater sector” growing ahead?

Bentley Team: With the rapid population growth and urbanization rate that India is seeing (jumping 2.63 percent from 2001 to 2011, according to India’s census), adequate water infrastructure must keep up with urban development. Existing water and wastewater systems continue to need to be improved and developed. There is still need for pipe replacement and repair, as well as an extension of existing water and wastewater systems to cater to population growth. In the last few years, we have seen new urban areas such as Navi Mumbai emerge with newly designed infrastructure.

Regarding water distribution, the current focus is on improving service levels for existing infrastructure. For example, there is a strong focus on reducing water loss, both leakage and water theft, so that nonrevenue water can be recuperated to improve water supply. Bentley water software, such as WaterGEMS, HAMMER, and Open Utilities, can help with remediating water loss. We recommend applying our water applications to the IWA Best Practices, which combine four strategies to address water leakage: Active Leakage Control, Pressure Management, Speed and Quality of Repairs, and Infrastructure Management.

Regarding wastewater, the government created the Atal Mission for Rejuvenation and Urban Transformation (AMRUT) with the objective to improve water and wastewater infrastructure, so we recently witnessed an increase in wastewater infrastructure projects, where new wastewater systems were built, improving sanitation services, hygiene, and reducing pollution in nearby water bodies such as rivers and lakes. Bentley’s SewerGEMS and SewerCAD hydraulic modeling products are helping many projects in India analyze and design effective wastewater systems.

What do you think will be the next biggest technology development in terms of Big data, Industry 4.0, and IoT...to really drive the water industry forward?

Bentley Team: To learn about your infrastructure, you must have data. Without data, utilities cannot really be informed about what is happening in their water and wastewater systems. However, this type of data-driven technology can only provide limited information. Utilities need to take the Smart Water Network approach to leverage their infrastructure data, a simulation application such as WaterGEMS is needed so that their water professionals can review the behavior of the system and the impact that any changes will have on the rest of the system. Simulation capabilities can also automate many aspects of water system analysis. For example, WaterGEMS includes optimization algorithms that assist with detecting water leakage, identifying the most energy efficient pump scheduling strategy, and finding the optimum designs and rehabilitation strategies. Ultimately, with Smart Water Networks, water utilities will not only increase their ROI on infrastructure data but also make better decisions about their water systems.

What are the latest solutions you are offering when it comes to “Urban Water Infrastructure” development?

Bentley Team: As a solutions provider to the urban water industry, Bentley brings together the capital and operational aspects of managing urban water infrastructure to realize gains on all sides. Bentley’s solutions span every step in the cycle, linking planners, engineers, construction staff, operations, and management with the information they need to implement the strongest asset performance strategies. Our software plays a key role in facilitating decision making about new and existing infrastructure, in each phase of the water lifecycle, determining the viability of legacy systems and optimizing the construction of new networks and treatment plants. BIM, hydraulic modeling, GIS, asset management, and reality modeling all serve as critically important solutions in making certain that investment in urban water infrastructure is spent wisely and effectively and that the systems will be in place for decades.

Can you cite a few recent cases of successful “international sewer & wastewater projects”?

Bentley Team: A few successful wastewater projects have taken the smart wastewater network approach, a recent emerging approach where utilities leverage existing infrastructure data in simulation software to make better-informed decisions about how to operate their wastewater systems.

In Brazil, AEGEA’s Smart Wastewater Management Network approach prioritized investments.

Prolagos provides water and sanitation services for five municipalities in Rio de Janeiro’s Region of the Lakes, where seasonal populations fluctuate from nearly 400,000 to more than 2 million. As an operator of the Prolagos concession, AEGEA Saneamento e Participações S.A. (AEGEA) prepared the Sewer Master Plan 2041 for expanding sewerage coverage from 76 to 90 percent and stopping contamination of Arraial da Lagoa.

SewerGEMS enabled AEGEA to model the 900-kilometer drainage network, incorporating GIS, CAD, and SCADA data to accurately...
Perrine Parrod

reflect the complex region and compare multiple scenarios for improving operational efficiency. AEGEA determined that future network interventions could reduce untreated discharges by 6.6 cubic meters per year; lower energy costs by BRL 700,000 per year; and reduce investments by 60 percent compared to prior plans.

In the heart of Antipolo City, Rizal, Philippines, Hinuhang Taktak waterfall and the park is a popular attraction and protected the landscape. In recent years, uncontrolled wastewater from rapid urbanization has degraded water quality and deterred tourists. Manila Water Company, Inc. developed a USD 40 million master plan to implement a sewerage system in the affected catchment area and restore the waterfall to its pristine condition.

Serving 150,000 residents by 2021, the project will include a 20 million liter-per-day sewage treatment plant and 12-kilometer sewerage network. Manila Water used SewerGEMS to design and analyze alternatives for network alignment, with scenarios mapped through GIS and integrated with land development plans. The software optimized the collection and conveyance system for pipe sizes, pump capacities, and heads to achieve the most economical capital and operating expenditures.

Last year Bentley Systems had acquired water modeling software business of “Action Modulators”. Can this platform support the Indian municipal agencies facing the challenges associated with climate change, rising sea levels, and increased incidences of flooding?

Bentley Team: Flood risk is the result of natural processes (e.g. intense precipitation), which are enhanced by climate change and by the impact of anthropogenic activities on the water cycle (e.g. soil sealing, river regularization). Risk mitigation on a municipal scale can be achieved by different actions, among them: (a) acting on the processes determining the rate of accumulation of water in a particular region; (b) reducing the socio-economic consequences of the floods; and (c) transmitting early warning so proactive measures can be taken. The flood modeling software acquired by Bentley helps with all above-mentioned actions. Regarding (a), MOHID Studio & MOHID Land can create detailed performance analysis on how specific measures will reduce the rate of accumulation (e.g. construction of the dams, retention basins, LiDIs). Regarding (b), MOHID Land can help define areas that are likely to be flooded and, together with municipal master planning, the socio-economic impacts can be reduced by prohibiting construction in areas that are likely to flood, for example. Action Flood can help with regards to (c). Having a reliable FEWS, which transmit early warnings, mitigates the impact by preparing response teams and protecting or evacuating people and goods from areas that will be affected.

Stormwater systems, storm drainage & sewer development projects can be very difficult to design and build. How can you help the engineers, urban master planners, and municipal agencies?

Bentley Team: Indeed, designing stormwater and stormwater drainage systems can be difficult because water always has to flow downhill, meaning that the design of such systems has to be gravity-flow based. Engineers need to determine elevations and pipe sizes that will provide enough capacity without requiring excessive excavation.

When inputting catchment and rainfall information, Bentley’s stormwater and sewer software applications such as StormCAD and SewerCAD, automatically compute the optimum pipe sizes and invert elevations that will provide sufficient capacity at the lowest cost. The automated design capability provided by our software products enable users to add constraints on design elevations, such as avoiding existing underground services/utilities. Also by providing the terrain model, our software applications can ensure that minimum cover is achieved throughout the stormwater system.

The automated design can also be generated from within CivilStorm or SewerGEMS (using StormCAD and SewerCAD gradually varied flow solved). If users want to analyze potential overflows, the Saint Venant equations need to be solved. To do this, users can choose between SewerGEMS/CivilStorm’s explicit EPA SWMM solver and the implicit dynamic wave engine. These two dynamic engines account for storage effects within structures and quantify flooding should it occur. Engineers can also use the SWMM water quality features to comply with water quality regulations. Tamil Nadu Urban Infrastructure Financial Services Limited (TNUIFSL) appointed Tata Consulting Engineers Limited (TCE) to prepare a detailed project report for integrated and always have to flow downhill. Water management facilities in the city of Salem, a municipal corporation covering 91.34 square kilometers. TCE analyzed the existing stormwater drainage system and developed a prioritized capital investments plan. TCE used StormCAD to analyze 1,100 kilometers of existing drains and perform hydraulic modeling of proposed drains. The software reduced design time by three months, optimized drain sizes, and reduced project costs. With this INR 745 billion project, TNUIFSL will help minimize flooding and improve stormwater collection and conveyance in Salem in the state of Tamil Nadu.

What is the latest update on “The Year in Infrastructure 2018 conference & awards”?

Bentley Team: The nomination deadline for the awards ended recently. More than 80 projects have been submitted from India, including a significant number of entries in water, wastewater and stormwater networks categories.

What are some of the specific water/sewage related solutions by Bentley for the ‘Construction and Buildings’ projects?

Bentley Team: The fact that infrastructure budgets are limited for consultants and constrained by revenue for owner-operators is an industry challenge. Consequently, Bentley understands that it is important for engineers to be as effective as possible on short-term infrastructure projects such as land development, construction, and building projects so that less time is spent on modeling and more time is spent on engineering.

Regarding land development projects, with Bentley’s easy-to-use hydraulics and hydrology software WaterCAD and SewerCAD, water professionals are ensured about the ability to cost-effectively deliver quality projects through advanced functionality providing accurate analysis and automated design. These capabilities result in high-quality design projects, customizable model outputs to streamline regulatory approval processes, and CAD- and GIS-platform support (with no platform restriction), all of which reduce project time. Treatment plant design and construction projects are a multidisciplinary problem. Bentley solutions provide all the necessary capabilities to design and build a treatment plant from the initial site grading to 3D visualization of the final design and efficient construction management and help EPCs do so in record time under budget, in a fully managed, collaborative team environment. Bentley’s plant, structural, and building applications are used together with ProjectWise around the world on projects ranging from small retrofits to existing facilities to the creation of large greenfield facilities.

Regarding asset performance, with Bentley’s AssetWise, asset performance and reliability strategies can be intelligently planned and implemented. AssetWise provides informed decision support from capital planning through proactive asset maintenance, which allows owners and their consultants to mitigate risk, increase operational efficiency, and ensure regulatory compliance. With improved information flow and interoperability that can be collected, water professionals in this industry can analyze and control relevant assets. AssetWise delivers actionable information that supports owner-operators’ business processes and drives the performance of their infrastructure assets.
Water Infrastructure - Need of the Time

One of the most critical aspects of the aging infrastructure is literally buried underground, out of sight and, usually, out of mind. When failures occur, then only we are reminded of how much we take for granted our access to safe drinking water.

By Subhash Sethi

The affliction point is the aging infrastructure across the country. One of the most critical aspects of the aging infrastructure is literally buried underground, out of sight and, usually, out of mind. When failures occur, then only we are reminded of how much we take for granted our access to safe, clean water.

Supporting 16% of the world's population is a daunting task considering that India possesses only 4% of the world's fresh water. Imagine the crisis that out of the very limited water availability, almost 80% of our surface water is contaminated. Nearly 60% of India's groundwater reserves are already contaminated with biological, organic, and inorganic pollutants. The Central Pollution Control Board (CPCB) has found that 18 major rivers in India are unfit for any domestic and industrial water usage.

Water Infrastructure

If current trends continue, India is set to become a water scarce country in not too distant future. The scarcity is looming large on Indian cities and water utilities are facing their biggest challenge from aging infrastructure across the country. One of the most critical aspects of the aging infrastructure is literally buried underground, out of sight and, usually, out of mind. When failures occur, then only we are reminded of how much we take for granted our access to safe drinking water. The water supply to household and businesses in cities depends on a network of aging underground pipes, many of which are reaching, or have exceeded, the end of their useful life. The pumping machineries are dilapidated and the number of water main breaks frequently.

In the past century, people have steadily moved from rural to urban areas to improve their standard of living as well as the quality of life. In 1901, only 11% of India's population was urban. A century later, over 34% of people are living in urban settlements which are expected to grow further to reach 80% in urban areas by the year we reach 2050. A rapidly increasing urban population and the expanding middle class have driven up water demand, while years of pollution, inefficient farming, decentralized governance, groundwater exploitation and poor infrastructure have depleted the water supply.

There are several challenges being faced by water utilities in India, but the ageing infrastructure is at the root of them all. In particular, urbanization and population growth contribute to water scarcity and intensify the strain caused by ageing infrastructure. Among other key challenges is the problem of water loss or non-revenue water. Global non-revenue water estimates range from 30 to 40% of water produced, whereas it is as high as 50 to 60% in several cities in India. Water utilities in India are faced with the need to address all of these challenges and revamping of infrastructure on priority for social, economic and environmental implications. For decades, we have invested heavily in fossil fuels - coal, oil, gas, and their derivative chemicals and plastic with little or no concern for consequences that today are evident in the form of pollution in water–we cannot drink, air–we cannot breathe, toxic environment around us and our failure to manage by-products and waste. In earlier days, we responded through a number of regulations, laws, and international treaties for water and made some progress in limiting and mitigating the consequences. Those restrictions, even the alternative strategies to replenish and recycle the resources are weakening and we are again returning to old values, policies, and behaviors which were considered obsolete and not relevant. Water utilities in India are now tasked with the job of attempting to conserve a previously unregulated natural resource as it quickly becomes a politicized source of contention for different groups within society.

This is an issue that needs urgent attention from policy makers, relevant government officials, private partners and people at large, especially in cities where urbanization has become a more serious problem. While urbanization is a very important consideration which all developing countries need to manage efficiently, a significant number of cities in India is witnessing rapid population growth and utilities are finding they have constructed much lesser infrastructure than they needed. We need to develop water and wastewater infrastructure sustainability policy that has to promote sustainable infrastructure in the water sector. The policy's objective should be to ensure that all investments, policies, and actions
support water infrastructure in the most efficient and sustainable manner to help water utilities, enhance economic competitiveness and promote affordable operation & maintenance.

SPML Infra has been promoting access to clean drinking water to all with sustainable water infrastructure development for more than three decades and has executed over 600 projects in water and wastewater segments along with other key developments. Being a leading player in the Indian water sector, it continuously features amongst the world’s top 50 private water companies. With a number of water infrastructure development and key executed projects, it is providing drinking water facilities to over 40 million people across several states in India.

**Water Storage**

India has a highly variable climate and vastly seasonal pattern of rainfall. Estimated 50% of rainfall happens in just 15 days and 90% of river flows during three to four months of monsoon period only. Investments in large-scale water infrastructure development in India have been very few and by all international comparisons, the country remains extremely short with such infrastructure.

India’s water harvesting and storage capacity from the rainfall is extremely limited compared to other arid countries such as the United States and Australia where they have built over 5,000 cubic meters of water storage per capita; China can store about 1,000 cubic meters per capita, India’s dams can store only 200 cubic meters per person. Moreover, India can store only about 30 days of rainfall, compared to 90 days in major river basins in developed countries. Water, especially in the water-rich north-east part of the country can be transformed from a curse to a blessing only if major investments are made in developing sustainable water infrastructure that will also deal with constant floods and drought situation. We need to recognize water as a stimulus for growth by combining major water infrastructure with a modern management approach. India needs to grow the capacity of its water storage from the existing about 200 billion cubic meters and it is more critical because of global climate change is going to have major impact in India, there is likely to be rapid glacial melting in coming decades in the western Himalayas and increased variability of rainfall in large parts of the country.

The large investments required in water infrastructure will help in augmenting the economic and social development of India. The assured supplies of water meant that crop yields on irrigated land were consistently much higher than yields from rain-fed agriculture, allowing India to achieve national food security and associated affordability of food. Hydropower from many of the large dams will provide the reinforcements for Indian industrial growth and groundwater irrigation. It is not just huge water storage infrastructure that is needed everywhere; in many parts of the country there are also substantial returns from investments in smaller-scale, community-level water storage infrastructure such as tanks, check dams, ground reservoirs, water harvesting and local water recharge systems. And there are massive needs for investment in water supply systems for growing cities and for underserved semi-urban and rural populations. India’s cities and industries also need to use water more effectively, and there will have to be massive investments in sewer networks and wastewater treatment plants.

This need arises because much of India’s existing water infrastructure is crumbling and so there is an enormous backlog of deferred maintenance. The end result is the familiar sight of crumbling, rusting, leaking pipes, dams, canals, and other vital water infrastructure.

**Financing Water Infrastructure**

The financing of water infrastructure is getting difficult for the government whereas the need for investment is becoming more critical and urgent. Although there is some investment being done by the government with new schemes and grants made available under AMRUT, Clean Ganga Mission, Water Supply and Irrigation Funds, Smart City Mission etc. The international funding for water infrastructure development has also increased from development agencies such as ADB, World Bank and JICA in the past few years. However, the overall investment required in the sector is estimated to be INR 620,000 crore (USD 129 billion). India currently spends about 6 percent of its GDP on infrastructure, less than several countries in Asia, and nearly half of the 11 percent invested by China. Both central and states’ governments are finding themselves increasingly constrained to fund large infra development projects for augmenting water supply and wastewater management. The financial needs of the water sector are growing exponentially with major gaps to meet the costs of rehabilitating the existing infrastructure and to build new facilities.

The budgetary allocations to the water sector are not sufficient as per the current requirement of infrastructure development and there is a large and growing financial gap, which can only be met by greater allocations of budgetary resources, more efficient use of these resources, and greater contributions from water users.

We could consider a combination of methods to promote sustainable water infrastructure:

- **Efficiency Management:** The utilities could emphasize on cutting costs and investing in water systems using a risk-based approach with adopting the best practices and bringing much-needed efficiency. The utilities must adopt new water efficiency at all levels from assets - pipeline, treatment, pumping, supply line, metering and set efficiency levels for manufacturers and others to promote water efficiency in operations and services.

- **Optimum Pricing:** Water in India is mainly subsidized and water utilities may consider charging the consumers for the full cost of construction, operation & maintenance of water systems that are essential for sustainability.

- **Watershed Approach:** The importance of infrastruc-
It gives me a deep satisfaction that we have been involved to provide clean drinking water facility to over 40 million people of our country.

In the state list, there is a need to recognize water as a finite and vulnerable resource. The government should take urgent action for comprehensive water legislation at the national level for effective water management, conservation, development and equitable distribution with regulatory authority to deal exclusively to provide complete control of water infrastructure from source to tap, metering, and billing with cost implications. The return on investment in the water sector should be enhanced through regulations to make the sector a rewarding business proposition for the private companies. With a number of PPP projects in water supply, SPML Infra had mixed experience with PPP projects for cities water distribution.

- **Public Bonds:** Bonds are useful for financing large water infrastructure projects that will generate services and income for many years, as the money can be repaid over time. The advantage to municipal and public utility bonds are typically tax-advantaged, which allows the borrowing entity to lower rates to investors.

- **Local Taxes:** The funding of water infrastructure can be done by levying some kind of local taxes from consumers rather than completely relying upon the government funding. The tax amount and period can vary depending on the requirements of specific municipalities with consideration of water availability and future demand.

- **Insurance, Pension Funds:** India has a huge reserve in insurance and pension segment and these funds can be utilized for financing water infrastructure projects directly or through the viability gap funding (VGF) scheme which is a one-time grant to augment public-private-partnerships (PPPs) projects to fill the funding gap and making projects commercially viable.

- **Development Finance:** Major development institutions such as the World Bank, Asian Development Bank, JICA and others provide funding for water infrastructure projects and also explore blended finance and local pooled finance facilities to mobilize private sector investment.

- **Alternative Rate Structures:** Water tariffs can be designed in such a way that encourages efficiency and conservation. This practice not only saves water but generate money for infrastructure development and management by making everyone aware that water is not a free or infinite resource. Utilities can consider higher water rates for any water used beyond the fixed quantity which will also improve the efficiency of its system operations.

**The Way Forward**

Water infrastructure is the need of time as our existing infrastructure is on the verge of perishing. Simply building additional infrastructure cannot enhance India’s looming water-stress. We need to consider a more integrated approach to create enduring value and wealth for the country and the organization. Under his leadership, SPML Infra went on to establish itself as a leading Engineering and Infrastructure Development organization in India over 600 completed projects in the domains of Water, Power, Sanitation, Environment, and Civil Infrastructure. The sustainable infrastructure created by SPML Infra helps water utilities to deliver safe and clean drinking water to about 40 million people of India.
Restoring existing water systems as they reach the end of their useful lives and expanding them to serve a growing population will cost at least USD 1 trillion over the next 25 years if the United States is to maintain current levels of water service.

By American Water Works Association (AWWA)

A NEW KIND of challenge is emerging in the United States, one that for many years was largely buried in its national consciousness. Now it can be buried no longer. Much of the nation's drinking water infrastructure, more than 1 million miles of pipes beneath its streets, is nearing the end of its useful life and approaching the age at which it needs to be replaced. Moreover, the country's shifting population brings significant growth to some areas of the country, requiring larger pipe networks to provide water service.

As documented in this report, restoring existing water systems as they reach the end of their useful lives and expanding them to serve a growing population will cost at least USD 1 trillion over the next 25 years if the United States is to maintain current levels of water service. Delaying the investment can result in degrading water service, increasing water service disruptions, and increasing expenditures for emergency repairs. Ultimately the nation will have to face the need to “catch up” with past deferred investments, and the more this is delayed the harder the job will be when the day of reckoning comes.

In the years ahead, all US residents who pay for water service will absorb the cost of this investment, primarily through higher water bills. The amounts will vary depending on community size and geographic region, but in some communities, these infrastructure costs alone could triple the size of a typical family's water bills. Other communities will need to collect significant “impact” or development fees to meet the needs of a growing population. Numerous communities will need to invest for replacement and raise funds to accommodate growth at the same time. Investments that may be required to meet new standards for drinking water quality will add even more to the bill.

Although the challenge to the US water infrastructure has been less visible than other infrastructure concerns, it’s no less important. The country's water treatment and delivery systems provide public health protection, fire protection, economic prosperity and the high quality of life its citizens enjoy. Yet most U.S. citizens pay less than USD 3.75 for every 1,000 gallons of safe water delivered to their taps.

This article demonstrates that as a nation, the United States needs to bring the conversation about water infrastructure above ground. Deferring needed investments today will only result in greater expenses tomorrow and pass on a greater burden to future generations.

The Era of Infrastructure Replacement

More than a decade ago the American Water Works Association (AWWA) announced that a new era was dawning: the replacement era, in which the United States would need to begin rebuilding the water and wastewater systems bequeathed to its citizens by earlier generations. AWWA's seminal report - Dawn of the Replacement Era - demonstrated that significant investments will be required in coming decades if the United States is to maintain the water and wastewater systems that are so essential to its citizens’ way of life.

The Dawn report likened to a silhouette of the Loch Ness Monster, revealed that each of the 20 water systems faced unprecedented needs to rebuild its underground water infrastructure - its pipe network. For each system, the future investment was an “echo” of the demographic history of the community, reflecting succeeding generations of pipe that were laid down as the community grew over many years. Most of those generations of pipe were shown to be coming to an end of their useful service.

Much of the drinking water infrastructure in the USA, more than 1 million miles of pipes beneath its streets, is nearing the end of its useful life and approaching the age at which it needs to be replaced. Moreover, the country’s shifting population brings significant growth to some areas of the country, requiring larger pipe networks to provide water service.
as the need to replace water treatment plants and storage tanks, and investments needed to comply with standards for drinking water quality. They also come on top of wastewater and stormwater investment needs which, judging from the most recent “gap analysis” from the US Environmental Protection Agency (USEPA), are likely to be as large as drinking water needs over the coming decades. Moreover, both water and wastewater infrastructure needs come on top of the other vital community infrastructures, such as streets, schools, etc.

Prudent planning for infrastructure renewal requires credible, analysis-based estimates of where, when, and how much pipe replacement or expansion for growth is required. This article summarizes the conclusions of a comprehensive and robust national-level analysis of the cost, timing, and location of the investments necessary to renew water mains over the coming decades. It also examines the additional pipe investments that can be anticipated can anticipate to meet projected population growth, regional population shifts, and service area growth through 2050.

This analysis is based on the insight that there will be “demographic echoes” in which waves of investment are driven by a combination of the original patterns of pipe investment, the pipe materials used, and local operating environments. The report examined the reinvestment demands implied by these factors, along with population trends, to estimate needs for pipe replacement and concurrent investment demands to accommodate population growth.

Although this report does not substitute for a careful and detailed analysis at the utility level of informing local decisions, it constitutes the most thorough and comprehensive analysis ever undertaken of the nation’s drinking water infrastructure renewal needs. The keys to the analysis include the following:

- Understanding the original timing of water system development in the United States.
- Understanding the various materials from which pipes were made, and where and when the pipes of each material were likely to have been installed in various sizes.
- Understanding the life expectancy of the various types and sizes of pipe (“pipe cohorts”) in actual operating environments.
- Understanding the replacement costs for each type and size of pipe.
- Developing a probability distribution for the “wear-out” of each pipe cohort.

**Key Findings**

**The Needs are Large**

Investment needs for buried drinking water infrastructure total more than USD 1 trillion nationwide over the next 25 years, assuming pipes are replaced at the end of their service lives and systems are expanded to serve growing populations. Delaying this investment could mean either increasing rates of pipe breakage and deteriorating water service or suboptimal use of utility funds, such as paying more to repair broken pipes than the long-term cost of replacing them. Nationally, the need is close to evenly divided between replacement due to wear-out and needs generated by demographic changes (growth and migration).

**Household Water Bills will Go Up**

Important caveats are necessary here because there are many ways that the increased investment in water infrastructure can be allocated among customers. Variables include rate structures, how the investment is financed, and other important local factors. But the level of investment required to replace worn-out pipes and maintain current levels of water service in the most affected communities could in some cases triple household water bills. This projection assumes the costs are spread evenly across the population in a “pay-as-you-go” approach (See “The Costs Keep Coming” below). With respect to the cost of growth, other caveats are important.

Many communities expect growth to pay or help pay for itself through developer fees, impact fees, or similar charges. In such communities, established residents will not be required to shoulder the cost of population growth to the extent that these fees recover those costs. But regardless of how the costs of replacement and growth are allocated among builders, newcomers, or established residents, the total cost that must be borne by the community will still rise.

**There are Important Regional Differences**

The growing national need affects different regions in different ways. In general, the South and the West will face the steepest investment challenges, with total needs accounting for considerably more than half the national total. This is largely attributable to the fact that the population of these regions is growing rapidly. In contrast, in the Northeast and Midwest, growth is a relatively small component of the projected need. However, the population shifts away from these regions complicate the infrastructure challenge, as there are fewer remaining local customers across whom to spread the cost of renewing their infrastructure.

This regional perspective reveals the inherent difficulty of managing infrastructure supply and demand. Although water pipes are fixed in place and long-lasting, the population that drives the demand for these assets is very mobile and changes in one community, leaving behind a pipe network of fixed size but with fewer customers to support it. They move into a new community, requiring that the water system there be expanded to serve the new customers.

**There are Important Differences Based on System Size**

As with many other costs, small communities may find a steeper challenge ahead on water infrastructure. Small communities have fewer people, and those people are often more spread out, requiring more pipe “miles per customer” than larger systems. In the most affected small communities, the study suggests that a typical three-person household could see its drinking water bill increase by as much as USD 550 per year above current levels, simply to address infrastructure needs, depending as always on the caveats identified above. In the largest water systems, costs can be spread over a large population base. Needed investments would be consistent with annual per household cost increases ranging from roughly USD 75 to more than USD 100 per year by the mid-2030s, assuming the expenses were spread across the population in the year they were incurred.

**The Costs Keep Coming**

The national investment the United States faces will roughly double from about USD 18 billion a year in 2010 to almost USD 30 billion annually by the 2040s for replacement alone. If growth is included, needed investment must increase from a little over USD 30 billion today to nearly USD 50 billion over the same period. This level of investment must then be sustained for many years if current levels of water service are to be maintained. Many utilities will have to face these investment needs year after year, for at least several decades. That is, by the time the last cohort of pipes analyzed in this study (predominantly the pipes laid between the late 1800s and 1960) has been replaced in, for example, 2050, it may soon thereafter be time to begin replacing the pipes laid after 1960, and so on. In that respect, these capital outlays come on top of those required to build a new treatment plant or storage tank, where the capital costs are incurred up front and aren’t faced again for many years. Rather, infrastructure renewal investments are likely to be incurred each year over several decades. For that reason, many utilities may choose to finance infrastructure replacement on a “pay-as-you-go” basis rather than through debt financing.

**Postponing Investment Only Makes the Problem Worse**

Overlooking or postponing infrastructure renewal investments in the near term will only add to the scale of the challenge the country faces in the years to come. Postponing the investment steepens the slope of the investment curve that must ultimately be met. It also increases the odds of facing the high costs associated with water main breaks and other infrastructure failures. The good news is that not all of the USD 1 trillion investment through 2035 must be made right now. There is time to make suitable plans and implement policies that will help address the longer-term challenge. The bad news is that the required investment level is growing, as more pipes continue to age and reach the end of their effective service lives.

As large as the cost of reinvestment may be, not undertaking it will be worse in the long run by almost any standard. Aging water mains are subject to more frequent breaks and other failures that can threaten public health and safety (such as compromising tap water quality and firefighting flows). Buried infrastructure failures also may impose significant damages (for example, through flooding and sinkholes), are costly to repair, disrupt businesses and residential communities, and waste precious water resources. These maladies weaken our economy and undermine our quality of life.
As large as the cost of reinvestment may be, not undertaking it will be worse in the long run by almost any standard.

This suggests that a crucial responsibility for utility managers now and in the future is to develop the processes necessary to continually improve their understanding of the “replacement dynamics” of their own water systems.

Those dynamics should be reflected in an Asset Management Plan (AMP) and, of course, in a long-term capital investment plan. The 2006 AWWA Report Water Infrastructure at a Turning Point includes a full discussion of this issue.

Conclusion

Because pipe assets last a long time, water systems that were built in the latter part of the 19th century and throughout much of the 20th century have, for the most part, never experienced the need for pipe replacement on a large scale. The dawn of the era in which these assets will need to be replaced puts a growing financial stress on communities that will continually increase for decades to come. It adds large and hitherto unknown expenses to the more apparent above-ground spending required to meet regulatory standards and address other pressing needs.

It is important to reemphasize that there are significant differences in the timing and magnitude of the challenges facing different regions of the country and different sizes of water systems. But the investments we describe in this report are real, they are large, and they are coming.

The United States is reaching a crossroads and faces a difficult choice. The nation can incur the haphazard and growing costs of living with aging and failing drinking water infrastructure. Or, the United States can carefully prioritize and undertake drinking water infrastructure renewal investments to ensure its water utilities can continue to reliably and cost-effectively support the public health, safety, and economic vitality of U.S. communities. AWWA undertook this report to provide the best, most accurate information available about the scale and timing of these needed investments.

It is clear the era AWWA predicted a decade ago - the replacement era - has arrived.

This article is an adapted excerpt from AWWA’s original Buried No Longer report, which can be downloaded in its entirety at www.awwa.org/buriednolongerreport. AWWA offers valued resources to water professionals around the world.
Introduction

According to data from the World Bank, India's 2015 population stands at 1.29 billion. This forms 17.2% of the world population at a growing rate of almost 1/8% p.a. (according to the World Development Report), with India predicted to overtake China as the world's most populous country by 2025.

The continued rapid growth of India's population will significantly impact its economy and urban resources, especially with regard to water and sanitation. Today, an estimated 600 million Indians have no access to modern sanitation, and only a fifth of the country's collected sewage is treated. A study conducted by the Water and Sanitation Program (2006) showed that the annual economic impact of inadequate sanitation in India amounted to an estimated USD 53.8 billion.

The running water supply of most Indian cities with populations exceeding 1 million is highly intermittent and under very low pressures due to the shortage of treated water and high water losses within underground pipe systems. Water supply planning, operations & maintenance are also not managed by a central authority, leading to low financial investments and a strong dependence on low capital subsidies from state governments.

A New Approach in Nagpur City

Maharashtra's second largest city, Nagpur spans an area of 217 sq km has a population that is expected to reach 4 million in the next 30 years.

Nagpur's water distribution network is owned by the Nagpur Municipal Corporation (NMC), who manages the long-term development of the city's water supply and sewage services. The NMC recently implemented a revolutionary “24x7” programme to improve the city's water supply under the project “Water for all and 24x7 supplies with a focus on safety, equity, and reliability” funded by the Jawaharlal Nehru National Urban Renewal Mission (JNNURM).

As with most Indian cities, Nagpur's water treatment plants are overloaded. Deficiencies in the system include low water pressure, high number of leakages requiring repairs, high level of non-revenue water, pollution and water-borne disease, and poor service delivery levels. A water and energy audit was conducted by NMC in 2005 to determine the upgrading needs of the existing water supply system.

The Water & Energy Audit

The water balance for the Nagpur water supply system is shown in Figure 1. It revealed that in 2005, NMC was purchasing and paying for 620 million liters per day (MLD) from the Water Resource Department. Of this, 140 MLD was lost during transportation from the treatment plants, with a further 20 MLD lost during treatment. Thus, NMC was only able to supply 480 MLD for the distribution system.

The results of and water and energy audit spurred a number of initiatives to improve water efficiency:

• New higher efficiency pumps.

24x7 Water Supply Project in Nagpur Uses Trenchless Installation with PE100 Black Pipes

The Nagpur Municipal Corporation (NMC) implemented a revolutionary 24x7 programme to improve the Nagpur city’s water supply under this project - water for all and 24x7 supplies with a focus on safety, equity, and reliability.

By Chanchal Dasgupta and Prashant Nikhade

Figure 1: Water Supply Situation in Nagpur

Figure 2 & 3: Some Typical Scenes from the Pilot Project in the Dharampeth Area of the City

Figure 4: Using HDD Installation in the Streets of Nagpur to Reduce the Disruption to the City Life

Figure 2 & 3: Some Typical Scenes from the Pilot Project in the Dharampeth Area of the City

Figure 2 & 3: Some Typical Scenes from the Pilot Project in the Dharampeth Area of the City

Figure 4: Using HDD Installation in the Streets of Nagpur to Reduce the Disruption to the City Life

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Figure 2 & 3: Some Typical Scenes from the Pilot Project in the Dharampeth Area of the City

Figure 4: Using HDD Installation in the Streets of Nagpur to Reduce the Disruption to the City Life
and improving water quality and the accountability of the water authority. The scheme structure is shown in Figure 2 where the Nagpur Environmental Company Limited (NESSL) grants a 25 year performance oriented leased contract to a Special Purpose Company (SPC) formed by the selected operator with recognised experience in improving O&M efficiency of source-to-delivery water supply systems and in implementing infrastructure investment projects in the water sector. The SPC will operate, maintain, repair, refurbish and provide for replacing any granted facilities from source-to-connection points and deliver water supply to consumers according to committed service levels targets. The 25-year contract was ultimately awarded to Veolia Water India. To accomplish this, Veolia set up Orange City Water (OCW), a joint venture with Vishvaraj Environment Ltd. The technical challenge of the project is considerable as it involves connecting 350,000 to 450,000 homes to the distribution network and increasing the amount of water available per person from 90 to 130 liters a day over the next five years. OCW’s USD20 million investment will cover renovations on the city’s water production plants and repairs and extensions the 3,000 km pipe network. The targeted production capacity of the system will be approximately 750 million liters a day and the leakage from the network, which is currently 60%, will be gradually reduced to meet international standards.

**Initial Pilot Project**

A pilot project was undertaken in the Dharampeth area of the city to validate scheme parameters and garner public feedback. Veolia and the consultants chose PE pipes and electro-fusion fittings after an evaluation based on JNNURM guidelines. The water piping system was designed for a maximum of 10 bar pressure using PE100 material water mains and MDPE PE80 pipes for house connections. The pipe jointing was carried out using electro-fusion fittings of up to 100mm and with butt fusions in larger sizes of up to 250mm.

Leak detection studies of the project area revealed that the tertiary network (150mm and below) was mainly responsible for the leaks, with 44% being galvanized iron main leaks and 37% from house connections. The major reasons for the commercial losses were faulty poor quality and aging meters, illegal connections, inefficient billing systems, non-existing structured consumer service centers and poor recovery mechanisms leading to corrupt practices.

To reduce the disruption to daily life, trenchless installation techniques, particular Horizontal Directional Drilling (HDD), were employed wherever possible.

**Project Implementation**

Following the pilot project, OCW worked with Borouge India to determine suitable PE materials for their HDD operations. High-Stress Crack Resistance (HSCR) PE100 compounds from Borouge were selected as they offer the best protection from scratches and scores on the pipe’s exterior during installation and any point loads that arising from stones or other hard objects in the soil. HSC PE100 materials are bimodal, with a Hexene comonomer rather than the Butene used in standard PE100 materials. This results in a PE molecular structure with more and longer side branches and in turn, stronger tie molecules that resist crack propagation through the pipe wall or dramatically slow down the process. This is measured by the Notched Pipe Test (NPT) under the international PE Water pipe specification ISO 4427. In this test, an HSC PE100 pipe will not fail within 10,000 hours as compared to the minimum 500 hours required by the specification for standard PE100 pipes.

The project specified the Indian Standard IS: 4984 with the ISO 4427 standard and included an extended slow crack test requirement for the PE100 material.

Training workshops were also conducted by Borouge India on the importance of using quality materials and the correct installation techniques.

**HDD Installation Using HSCR PE Pipes Keep Project on Track**

One of the major concerns highlighted in the pilot project was to use HDD during the installation process to reduce the overall disruption of the city as much as possible. Other benefits of HDD include:

- Avoiding damages to other utilities not mapped on the plan that causes inconvenience and penalties
- Avoiding lengthy clearance procedures for open trench digging of roads and traffic diversion
- Maintain the PE pipe installation rate and keep the project on schedule
- Minimize disturbance to congested urban areas
- Avoid restricting access to hospitals or other important public buildings.

The determination of HDD installation sites are on a case to case basis and conducted by local site engineers and the consultant team. The minimum length for an HDD installation was set at 50m, with 200m as the maximum depending on site conditions. PE pipe lengths in terms of percentage of the total length executed are as follows:

- 110 mm - 90% (HDD bore size 150 mm),
- 125 to 160 mm - 9% (HDD bore size 200 or 250 mm),
- 180 up to 250mm - 1% (HDD bore size 350 mm)

The total length of mains installed by HDD would be around 190 km - almost 30% of the total network length, making it the first time in India where HDD is used so extensively in a water network project.

One of the key benefits of HDD installation enjoyed by OCW is the timely execution of the project. There was also zero incidence of pipe failure during the process.

**Conclusion**

The HDD technique for installing PE water pipes in Nagpur city in India has proven to be beneficial by significantly reducing the overall costs and environmental impact. The HSCR PE 100 material for critical HDD applications will provide the most reliable and enduring service life of the water networks, giving the utility operator a “peace of mind”. India’s first PPP 24x7 water supply project is an excellent case that demonstrates how a utility company can benefit from collaborations with the pipe, equipment, and raw material suppliers.

**About the Authors**

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Addressing the Gaps in Water Infrastructure Needs

By Joseph Kane

U.S. Households are Using Less Water, but What Does That Mean for Metros and Infrastructure?

The last few months have seen a growing number of climate concerns - from historically devastating floods to record forest fires. Beyond recovery, planning and paying for more resilient infrastructure also remains an enormous challenge.

One bit of positive news came out recently, though: as the drought in the Western United States has eased, many households are using less water and putting less strain on the country's scarce water resources. According to a new report from the U.S. Geological Survey (USGS), U.S. household water use is on the decline, approaching levels not seen since the mid-1990s. Steps toward greater water conservation in California and several other states appear to be taking hold, alongside a number of regulatory and technological advances in support of water efficiency, including plumbing fixture upgrades. And with greater efficiency come several benefits: from preserving long-term water supplies to reducing the need to build new infrastructure.

Still, even as households use less water, these drops are not equal nationally, and ongoing challenges remain concerning water efficiency and affordability in many regions.

As our recent report on metropolitan water use highlights, utilities - alongside other local and state leaders - are striving for a cleaner, more reliable water service, but they must often do so amidst increasingly unpre-
dictable water demands and mounting infrastructure costs, which results in higher water bills for many households. With more timely and geographically detailed information, however, they can more easily measure and define their water needs - and ultimately design the plans, develop the asset management strategies, and deploy the technologies in support of more efficient and equitable outcomes. The latest USGS report helps clarify what these needs look like at a household level, but now it's up to local leaders to monitor and address them.

For example, recent national trends only reveal part of the story. U.S. households reduced their water use nationally by almost 850 million gallons each day from 2010 to 2015, a 3 percent decline (based on Brookings analysis of aggregated county totals, as reported by the USGS). This reduction came even as the U.S. as a whole saw its population increase by 12 million people (or 4 percent) over the same time span. Put together, this means that residential water use per capita fell from 88 gallons each day in 2010 to 82 gallons each day in 2015 - a far cry from the 98 gallons each day in 2005.

Many of the country's most populated metro areas are leading this charge toward more efficient water use. Households in the 100 largest metro areas reduced their water use by 725 million gallons each day from 2010 to 2015 - meaning they were responsible for 85 percent of the U.S. decline, despite accounting for two-thirds of its population. As shown below, five of the 10 metro areas with the greatest declines were found in California, led by Los Angeles (-180 million gallons each day), Riverside (-106 million), and San Francisco (-86 million), all while seeing significant gains in population. Consequently, residential water use per capita in these metros also tended to be below national averages.

Yet, multiple other metro areas actually saw an increase in residential water use. In fact, households in 50 of the 100 largest metro areas used more water each day in 2015 than they did in 2010, revealing clear room for improvement in achieving greater efficiencies. Among the 10 metro areas with the biggest gains, several represent sprawling Sun Belt metros, such as Atlanta (+39 million gallons each day) and Phoenix (+28 million). Not surprisingly, continued population growth and development in many of these markets translated into further rises in residential water use per capita as well.

For the most part, continued declines in household water use show that the U.S. as a whole is making great strides toward a more efficient, cost-effective service, but that is not true across the board. On the one hand, some areas are ahead of the curve, particularly in drought-stricken parts of the West where water conservation has not only become a necessity and way of life but has also benefitted from forward-looking planning focused on environmental stewardship and economic stability. On the other hand, some areas along the Colorado River and elsewhere are grappling with rising water demand and challenges collaborating on region-wide planning approaches, including more responsible groundwater management.

Still, even as households use less water, these drops are not equal nationally, and ongoing challenges remain concerning water efficiency and affordability in many regions.

To achieve greater long-term certainty managing their water resources - in addition to planning and paying for any needed infrastructure investments - utilities and their local and state partners should continue monitoring these trends closely. Doing so requires ongoing attention to the infrastructure itself, including technological upgrades and water supplies, but also a prioritization of water's role in the larger built environment and economic development efforts. Areas with dense, compact development patterns, for instance, tend to use less water, and planning strategies should continue making it easier for all households to gain the affordable water access they need to survive and thrive. The U.S. faces sizable water infrastructure needs, but many areas are already getting a head start on addressing their gaps in this way and should serve as models to consider for future improvements.

Investing in Water Infrastructure and Workers: Examining the Bay Area’s Regional Approach

Investing in water infrastructure represents a major challenge and opportunity across the United States. As pipes, plants, and other facilities reach a breaking point, utilities and local leaders must plan and pay for increasingly costly repairs. However, many places have responded with innovative approaches, using new management techniques and modern technologies to deliver water infrastructure that is more cost-efficient, durable, and resilient.

Crucially, these challenges and opportunities do not simply end with the infrastructure itself.

The country's water workforce is also undergoing change. Similar to millions of other workers involved in infrastructure nationwide, the water workforce is aging, experiencing rapid turnover, and facing a huge gap to fill in terms of hiring, training, and retention - from operators and engineers to accountants and office clerks. At the same time, these jobs offer competitive wages, have lower educational barriers to entry, and consequently provide a pathway to greater economic opportunity for all types of workers across all skill levels.

While many localities - and water utilities, in particular - continue to struggle to fill these positions, some places are leading the charge...
toward more coordinated, proactive recruitment and training. California’s Bay Area represents one such national leader.

Like most parts of California, the Bay Area faces a confluence of environmental and economic concerns. The state is ground zero for a variety of national water challenges, including water scarcity and affordability issues that extend to the Bay Area. Of course, getting even more attention are the region’s economic issues, including its astronomical cost of living and rising income inequality.

However, forging new partnerships and programs across the entire region, Bay Area water utilities are working closely with one another and various community groups to tackle these challenges head-on — with a particular emphasis on workforce development. Although most utilities across the country remain highly fragmented and localized in their operations, capital planning, and workforce development strategies, the Bay Area demonstrates how to build additional financial and technical capacity in support of the water workforce, often through broader regional collaborations.

Individual utilities, public agencies, workforce organizations, and regional coalitions: each is instrumental in hiring, training, and retaining workers at a larger scale. The efforts begin within individual utilities and public agencies that depend on forward-looking leadership to implement more purposeful, long-term programming. The San Francisco Public Utilities Commission continues to play a lead role — both regionally and nationally — in driving the creation and implementation of youth work programs, local job training programs, and other strategic plans in support of a more skilled, diverse workforce. Similarly, the East Bay Municipal Utility District promotes awareness and outreach for careers in the water sector through diversity initiatives and internship programs. Toward the South Bay, the Santa Clara Valley Water District and the City of San Jose, each spearhead efforts focused on targeted recruiting, skills development, and a more inclusive workforce.

This sense of shared responsibility helps set the table for BAYWORK, a consortium of Bay Area water and wastewater utilities focused on workforce development. This multi-stakeholder approach helps provide a regional platform to coordinate utility and community-wide activities. In addition to holding workshops, meetings, and other events to promote greater regional collaboration around (and visibility of) the workforce challenge, BAYWORK also uses new research and other workforce resources to help clarify strategic priorities. For example, by identifying the skill needs and current positions available for mission-critical occupations, such as water treatment operators, machinists, electricians, and electronic maintenance/instrument technicians, BAYWORK is supporting additional community outreach and building local capacity to hire and train that specific workforce.

To be sure, prioritizing regional workforce development does not simply begin or end within the walls of utilities; the need for broader collaborations with workforce groups, local educational institutions, unions, economic development officials, and political leadership is essential to build additional capacity for these efforts.

Among the Bay Area’s numerous workforce organizations, for instance, Jewish Vocational Service (JVS) is helping utilities find qualified candidates by connecting workers with training opportunities and stewarding new partnerships. Similarly, Young Community Developers (YCD), a non-profit group with activities concentrated in San Francisco’s Bayview Hunters Point neighborhood, provides job-readiness training and job placement assistance to residents who may face significant barriers to launch water careers. A number of high schools and technical schools, such as Los Medanos College and Laney College, also remain instrumental in helping students gain essential skills and on-the-job training through direct partnerships with utilities.

Individual utilities, public agencies, workforce organizations, and regional coalitions: each is instrumental in hiring, training, and retaining workers at a larger scale. Indeed, for other regions looking to replicate the Bay Area experience, it is the coalition of partnerships and the emergence of shared strategies that deserve closer attention. Recruitment, for instance, must touch all corners of a community to attract more workers and achieve greater diversity, which depends on gaining traction among a broad set of regional players. To promote more inclusive economic development, utilities and local leaders must be able to tap the talent of the entire region, and water jobs must be more accessible to more prospective workers in more places.

Of course, adopting such a shared, regional approach flies in the face of the jurisdictional fragmentation and competition that frequently exists in the water sector. Many utilities lack the staffing and budgetary capacity to create new recruitment and training programs or struggle to connect with other regional partners, as their workers retire or leave for opportunities elsewhere. Moreover, hiring additional workers and setting up pathways for continued learning are part of a winding, long-term process, which requires monitoring and evaluation. Utilities must also contend with an ever-growing number of financial and programmatic responsibilities that can be hard to balance all at once. Even regions with a track record of success like the Bay Area are not immune to these challenges.

While all of these issues can increase the degree of difficulty of filling the water workforce gap, they do not reduce the need. The clock is ticking for many utilities and other employers nationally, and the need to accelerate workforce development is only growing. However, having a collective, aspirational mindset that prioritizes workforce development at a regional scale is an important start — and it’s an approach worthy of replication.

Source: The Brookings Institution Metropolitan Policy Program

About the Author

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Similar to millions of other workers involved in infrastructure, the water workforce is facing a huge gap to fill in terms of hiring, training, and retention.
Emergency Sanitary Sewer Line Repair Done Down Deep

Crumbling pipe undermined upstate New York Island.

By Advanced Drainage Systems (ADS)

THE FINAL STRAW for a long section of the sanitary sewer line here was a sinkhole "large enough for a dump truck" and sewage that flooded local residences and businesses during August 2013. Running under Whitehaven Road, the main east/west multi-lane street, the 35-year-old, 30-inch diameter asbestos cement pipe (ACP) failed due to "swamp gas" - hydrogen sulfide gas, a naturally occurring result of decomposing sewage present in gravity flow sanitary sewers. Six hundred and fifty feet of 30-inch diameter SaniTite® HP triple-wall polypropylene pipe replaced the failed ACP at depths of 22 to 24 feet.

Due to the extreme nature of the pipe failure and because the Town of Grand Island is surrounded by the Niagara River, it was imperative that the destroyed pipe between Grand Island Blvd. and Stony Point Road be replaced to prevent further damage to homes and buildings, and to stop any effluent from flowing into the Niagara River, eventually over Niagara Falls, causing a potential environmental disaster. The USD 500,000 emergency repair took a month to complete.

Since the 1700’s the Town of Grand Island has been a resort, a lumber town, a colonial battleground, part of the City of Buffalo and part of nearby Town of Tonawanda. Today, it is the home for more than 20,000 residents and hundreds of businesses, ranging from small stores to major corporations with 500 people and more. The island town is eight miles from Niagara Falls.

"We had an asbestos cement pipe that over the years was being eaten away by hydrogen sulfide gas," explained John Whitney, P.E., Grand Island engineer. "This pipe originates upstream and the end of it is a tributary to a very long force main. Sewage goes septic in that force main. When it gets discharged into the gravity sewer, which is the 30 inch ACP, hydrogen sulfide gas mixes with air and you end up with various permeations of sulfuric acid. That is very destructive to cement and the pipe got so thin it just collapsed. It had already caused a sinkhole the size of a dump truck and 27 feet deep."

Among other plastics, polypropylene is inert to the effects of hydrogen sulfide present in sanitary sewers, making it a highly recommended material of choice to replace deteriorating infrastructure across the country. SaniTite HP has been used in similar emergency repairs to replace failed infrastructure in Kentucky, Mississippi, Ohio, and Pennsylvania.

"In other sections also, there was a tremendous amount of dirt that had infiltrated into the pipe from cracks," he said. "We ran a camera in there and looked upstream from one of the downstream manholes and saw that the dirt went right to the ceiling of the pipe. And because the pipe was in such a deteriorated condition, we would not have been able to..."
clean it without destroying it. We replaced it in the same trench with the SaniTite HP pipe."

SaniTite HP pipe is a product of Advanced Drainage Systems, Inc. (ADS) (NYSE: WMS) (Hilliard, Ohio). Manufactured in 30 to 60 inch (750-1500mm) diameters, it is available in triple-wall construction, as was used for this project, that provides a smooth interior and exterior wall design supported by a corrugated structural core for improved stiffness and greater beam strength to minimize deflection and enhance long-term performance. It meets ASTM F2736, ASTM F2764 and also exceeds the requirements of ASTM D3212 for water tightness with dual-gaskets and banded reinforced bell. Rugged and lightweight, the pipe is easily handled with minimal equipment and crew. Its stick length reduces the number of joints, which also saves time and labor and makes for a more secure system versus the several-ton weight of each short section of comparable concrete pipe.

According to Bill Kelley of Lock City Supply (Lockport, NY), who provided the materials for the job, "This was a very deep cut near a very busy highway, and the repair had to be done quickly and safely. Not only is the pipe we used a good quality product, but it was also easy to install, and we could get it delivered to the job site from a nearby plant. If ever there was a case to prove the benefits of this pipe, this was it. It truly is the next generation of the pipe."

Aside from the depth, the project also had other challenges including a one-and-a-half inch rainstorm, a ductile iron pipeline that had to be cut and reinstalled, plus high-voltage electric lines overhead.

"The break was right in front of a water pumping station with a three million gallon water tank," Whitney explained, "and there was a fit-inch ductile iron water transmission main which we had to cross. The only way to do this was to physically isolate it, cut the line, run the new sanitary line and then reinstall the iron pipe.

"We were also adjacent to the National Grid power transmission lines coming out of Niagara Falls that carry 230,000 volts. This meant that we had to have a high-voltage certified electrician with us and have the equipment grounded all the time."

During the repair, the crew used eight inch and 12-inch pumps to bypass the area. A doghouse manhole was used to tie in the new SaniTite HP pipe with the existing ACP.

"The new pipe worked out great. The procurement was very rapid, the cost was favorable and it went together very well," said Whitney.

Advanced Drainage Systems (ADS) is the leading manufacturer of high-performance thermoplastic corrugated pipe, providing a comprehensive suite of water management products and superior drainage solutions for use in the construction and infrastructure marketplace. Its innovative products are used across a broad range of end markets and applications, including non-residential, residential, agriculture and infrastructure applications. The company has established a leading position in many of these end markets by leveraging its national sales and distribution platform, its overall product breadth and scale and its manufacturing excellence. Founded in 1966, the company operates a global network of approximately 57 manufacturing plants and over 33 distribution centers.
Compare Trenchless Methods for Water Main Rehab

Every day, water utilities face major challenges of renewing aging underground infrastructure. Trenchless technologies offer several approaches for rehabilitating and renewing old, crumbling underground water pipelines.

By Behnam Hashemi and Md. Mo Najafi

A LARGE PORTION of North America’s underground water infrastructure was installed during the 1950s and 1960s during a period of rapid economic growth in Canada and the United States. Today, on average, these systems are more than 70 years old and have deteriorated to the point that failures are daily news.

According to the American Society of Civil Engineers’ 2017 Infrastructure Report Card, which gave US water infrastructure a “D” grade, an estimated 240,000 water main breaks occur each year in the more than 1 million miles of water pipe beneath US streets. Such breaks waste more than 2 trillion gallons of treated drinking water annually.

As documented in AWWA’s Buried No Longer report (www.awwa.org/buriedno-longer), restoring existing water systems as they reach the end of their useful lives and expanding them to serve growing populations will cost at least USD 1 trillion during the next 25 years. The US Environmental Protection Agency estimates there are nearly 17,000 US public drinking water systems, including 54,000 community water systems, that serve more than 246 million people. Out of these systems, approximately 4,000 to 5,000 miles of drinking water mains are annually replaced. This replacement rate is projected to be around 16,000 to 20,000 miles by the year 2035.

Traditional pipeline replacement or renewal methods use expensive open-cut excavation that disrupts citizens’ lives, with costs escalating dramatically in developed areas and in projects with difficult site conditions. In contrast, trenchless technologies use innovative methods, materials, and equipment that require minimum surface excavation to renew aging underground infrastructure. These new methods are considered safer and more cost-effective, efficient, and productive than conventional open-cut projects.

Trenchless Technologies

Selecting a trenchless pipeline replacement or renewal method depends on the physical conditions of the existing water pipe, including pipe length, material type, size, service connections, bends, and the nature of the problem or problems involved. Problems with an existing pipe may include structural or non-structural conditions, exfiltration or outflow, pipe breakage, joint or pipe misalignment, hydraulic capacity, corrosion, abrasion, and water quality problems. Features of a replacement or renewal system also should be considered, such as project applicability, constructability, cost factors, service provider availability, and the new pipe’s life expectancy and future use.

The following sections briefly describe and compare Cured-In-Place Pipe (CIPP), Spray-In-Place Pipe (SIPP), Carbon Fiber Reinforcement Polymer (CFRP), and Pipe Bursting (PB). Other common trenchless renewal and replacement methods in the water industry are slippiping and close-fit, which aren’t covered here.

Cured-In-Place Pipe

CIPP is a well known trenchless technology used for structural and non-structural pipeline renewal. The process involves inserting a liquid thermoset resin material into the host pipe and curing the material with hot water, steam, or ultraviolet light. The liner material is typically polymeric felt fiber or woven fiberglass tube. Lateral reconnection can be done internally without excavation using a robotic cutter.

According to AWWA’s Manual of Water Supply Practices M28, Rehabilitation of Water Mains, there are four structural levels defined for lining techniques. Class I is non-structural systems used primarily to protect the inner surface of the host pipe from corrosion. Class II and III linings are interactive and semi-structural systems. Finally, class IV linings are considered fully structural or structurally independent with two characteristics: A long-term (50-year) internal burst strength and the ability to survive without the host pipe support, considering any dynamic loading associated with the host pipe’s sudden failure because of internal pressure loads.

Characteristics

CIPP technologies can cover water line diameters ranging from 6 in. to 60 in. Small-diameter service connections (~2 in.) are reinstated using robotic equipment, thereby avoiding excavations in front of every home. CIPP technologies used for potable water should be certified to NSF/ANSI standard 61. This method works in varying soil conditions. When high groundwater levels are encountered, liner thickness should be sufficient to address additional groundwater loading. Following are CIPP’s major characteristics:

- Good for pipes with exfiltration and minor structural defects
- Capable of negotiating bends and deformations in the host pipe, depending on the size of the pipe and CIPP method used (invert- ed or winch)
- 50-year lifespan

Access and Excavation Needs

EXPRESS WATER
Unlike sewer systems, water systems don’t have access holes, so water main renewal using CIPP generally requires excavating two pits to provide pipe access. As a trenchless method, CIPP minimizes surface disruption, but flow bypass is required during the installation and curing processes.

**Advantages**

Besides the need for open-cut access points, minimum excavation is favorable for CIPP; small-diameter service connections are reinstated from inside the pipe without any excavation. Although a CIPP liner’s inside diameter is slightly less than the host pipe, it will increase hydraulic capacity because of the liner’s smooth interior surface. Volatile organic compound (VOC)-free resins are used for potable water (no styrene). Reconnections at the pits can be accomplished with common pipes and fittings. Although CIPP negotiates minor bends and deformations, it can’t renew severely deformed pipes.

**Limitations**

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is defined by depth and ground conditions as described in OSHA regulations. The required pit length is determined by the minimum safe bending radius recommended by the manufacturer.

Service laterals can be reconnected with specially designed fittings by various methods. The saddles, made of a material compatible with that of new pipe, are connected to create a leak-free joint. Different types of mechanical connections and fused saddles, such as electro-fusion and conventional fusion saddles, are installed according to manufacturer-recommended procedures. New service laterals can be connected to the pipe by compression-fit service connections. A small excavation is required at every service connection that needs to be reinstated.

Pipe bursting can be applied to a wide range of pipe sizes and types in a variety of soil and site conditions. The size of pipes being burst typically ranges from 2 in. to 48 in., although some projects have used larger diameters (e.g., 80 in.), and more sizes will be possible with larger equipment in the future. The most common PB method is size-for-size, or upsizing the diameter of the existing pipe up to three sizes (e.g., 8 in. to 12 in.). Large upsizing requires more energy and may result in ground movement. The larger sizes slow the replacement operation and require careful evaluation and project planning.

Pipes suitable for PB are typically manufactured of brittle materials, such as vitrified clay, cast iron, plain concrete, asbestos, or some plastics. If it isn’t heavily reinforced, reinforced concrete pipe can be successfully replaced; it can also be replaced if it’s substantially deteriorated. Thanks to recent improvements, ductile iron, and steel pipes can be replaced with PB using a static method.

Common Trenchless Renewal and Replacement Methods in the Water Industry Include: Cured-In-Place Pipe (Figure 1), Spray-In-Place Pipe (Figure 2), Pipe Bursting (Figure 3), and Carbon Fiber Reinforcement Polymer (Figure 4).

Advantages
PB’s ability to upsize a pipeline gives it a unique advantage compared with other trenchless techniques. For example, a 41 percent upsizing doubles a line’s capacity without considering the effect of the new pipe’s smoother surface. Also, compared with other trenchless techniques, PB is more cost-effective in cases in which few service connections are to be reinstated within a replacement section, when the host pipe is structurally deteriorated, and when additional capacity is needed.

Limitations
Excavation is required to reinstate service connections and at every change in direc-
Selecting a trenchless pipeline replacement or renewal method depends on the physical conditions of the existing water pipe, including pipe length, material type, size, service connections, bends, and the nature of the problem or problems involved.

Except for pre-stressed concrete pipe and precast concrete cylinder pipe, which aren’t economically feasible for PB using existing technologies, all other pipe materials are feasible for CIPP, SIPP, and CFRP.

**Access Point Excavation**
For operator entry large-diameter sizes (36 in. and above), all methods require access pit excavations. However, PB typically requires larger excavations because of the continuous nature of the new pipe. In smaller sizes, access pit excavation might be minimized to any appropriate pipe connection or valve, but only CIPP and SIPP devices can pass through smaller spaces. CFRP is applied by hand, so that approach requires larger entry and exit pits.

**Bypass Pumping**
A water bypass is typically required when using these methods in distribution water main renewal. However, because PB’s process time is somewhat longer, it would need more bypass pumping, so costs would increase, especially with large-diameter sizes. In contrast, SIPP installations, in certain cases and shorter installation periods, may skip bypassing.

**Structural Enhancement**
All four methods can provide full structural renewal, but SIPP needs to be adjusted and enhanced to do so.

**Existing Pipe Material**

There are Pros and Cons for All Four Methods, so the Project Conditions Play a Large Role in Which Approach is Selected.
Advancing Management of Urban Water Infrastructure

This article examines how technology and the ever-increasing capabilities of software solutions are enabling better-performing projects and assets, predicting issues and proposing solutions, and reducing operating costs for utilities around the world.

By Cyndi Smith

The global water market - that is to say, the sum of both operating and capital expenditures by utilities and industrial water users of both water and wastewater - is currently estimated to be worth USD 714 billion globally. It is expected to grow at an average annual rate of 3.8 percent until 2020.1 This massive enterprise takes place on the local level in every community in the world - and every local water utility requires thorough and careful management.

Let’s take a close look at the issues facing water utilities today and on the near horizon so that we may understand how technology solutions can make a positive difference in the water infrastructure lifecycle.

• Improved water efficiency in response to pressures on water supply: Global climate change is taking its toll on the water cycle, making water scarcity an ever-greater issue. The Fanine Early Warning System Network forecasts grain shortages due to drought conditions in South Africa. In Ethiopia, the severest drought since the 1960s may cause another famine. In the United States, rain and snowfall shortages have diminished the Colorado River.2

• Greater emphasis on wastewater treatment in growing cities: Rapid urban and industrial growth places significant pressure on the environment. The United Nations (UN) reports that in the coming decades, 95 percent of the urban expansion will take place in the developing world, especially in Asia and Africa.3 The UN says that every day 2 million tons of human waste are disposed of in untreated waterways, leading to pollution of ground and surface water resources.

• The need to manage increased volumes of sludge: With more wastewater treatment investment comes more sludge, without a disposal strategy. Methods in place include land use, which may bring up issues involving heavy metal content and other risks, especially in developing countries. Deregulation of sewage sludge treatment is on the horizon in the United Kingdom, which may spur new opportunities for wastewater treatment plants around the world.

• Structural change in the management and finance of utilities: Utilities have felt pressure to change the way they are managed and financed for some time, but most do not have the resources to respond. New financing practices include private activity bonds, special subsidized bonds, infrastructure equity funds, water-focused loans, and state revolving funds. These may be required to work around the lack of infrastructure spending by the United States government. Other countries may have models that could work for individual utilities.

The Urban Water Lifecycle

These trends impact every stage of the water lifecycle, especially in developing countries receiving their first modern urban water systems. The software can facilitate solutions to resulting issues occurring from the planning stages through construction and operations, using simulation, modeling, and analysis to bring conditions and obstacles to light. Not only does this allow urban water organizations to plan for potential scenarios before a shovel hits the ground, but it extends to daily operations, proactively addressing potential issues before they become problems. The following examines challenges and software solutions for the urban water lifecycle.

• Uncertainties in private financing: Private investment has not swung its interest toward the water, even though many countries are looking to the private sector as a source of funding for infrastructure improvements.

• Greater reliance on technology to drive performance: The water industry has been hesitant to adopt new technologies. Utilities tend to value safety over financial gain, and industrial users typically ignore water because it represents a negligible operational cost. Today, however, with a wide range of hazards threatening the ability to bring water to end-users, the focus has shifted to technologies used in risk-based planning and emergency preparedness, as well as applications that can reduce total expenditures across the lifecycle.

• Networks remain at the heart of utility operations: The biggest potential opportunity in the water market is the need to extend safe and convenient water services to all. In 2017, according to the World Health Organization, 2.1 billion of the world’s 7.4 billion population do not have access to a reliable 24/7 potable water supply.

Stormwater Networks

To have confidence in stormwater conveyance systems, urban water management must simulate and examine its performance under a range of conditions. These systems are hard to model, with flow backups and reversals, surcharged pipes, and so on. Stormwater modelling and analysis solutions allow users to model and examine potential storm events, land uses and runoff characteristics, and other basin drainage conditions. Different automated and manual designs can then be evaluated and
The Integrated Design Approach Used for the Googong Water Recycling Plant Reduced Potable Water Consumption by 62%.

compared for these different conditions, ensuring that the final system will perform well no matter what Mother Nature throws at it.

Bentley's CivilStorm stormwater modeling and analysis application provides comprehensive system modeling, with the ability to analyze pressure and free surface flow conditions through networks of channels and closed conduits. CivilStorm performs analysis of all aspects of stormwater systems: rainfall, runoff, inlet capture and bypass, gravity and pressure piping, ponds, outlet structures, open channels, culverts, and more. Design can be effortless since CivilStorm recommends the most cost-effective pipe sizes and invert elevations while meeting design restrictions. It guides you through the complex pond and outlet design process and streamlines complicated culvert hydraulics. Users can run CivilStorm within familiar platforms like MicroStation or AutoCAD, or in its stand-alone interface to minimize capital investments and detect system bottlenecks, improve capacity, and limit stormwater flooding to comply with stormwater regulations.

CivilStorm played a key role in stormwater management in Dholera, an ancient port city in India. The development of Dholera marks a new stage of growth for India that will drive economic growth and generate jobs in the region. The Delhi Mumbai Industrial Corridor Development Corporation aims to enhance India's manufacturing base by developing a 920-square-kilometer city that will employ state-of-the-art green infrastructure. The first 22.5-square-kilometer USD 500 million phase is under construction and planning is underway for the next 153 square kilometers at a cost of USD 5 billion. As the program manager, AECOM employs advanced technologies to accelerate planning and decision making.

Flat, low-lying terrain in Dholera makes storm networks a particular challenge, as stormwater management requires more than 30-meter wide concrete ducts to carry stormwater under roads. The use of Bentley's stormwater modeling and analysis software saved the project USD 45 million by designing an open channel in the center of the city that would collect, harvest, and allow reuse of stormwater, repurposing the area for irrigation and as a public park.

Water Treatment

Urban expansion, modernization, and other issues have resulted in the development of new water and wastewater treatment facilities and the upgrading of existing ones. Water and wastewater treatment plant design is a large-scale, complex engineering effort that requires a multi-discipline design team and involves collaboration among different consulting firms, contractors, and owners. Greenfield and brownfield projects require team collaboration, in a comprehensive modeling and connected data environment. Multi-discipline plant design applications are required, as well as modelling of complex structures. For upgraded and retrofitted plants, project teams need to reuse legacy P&ID drawings, create intelligent P&IDs for managing tags in the facility, and use reality modeling with point clouds and photographs to capture existing plant conditions. Ultimately, the design process should result in intelligent digital engineering models that allow information to be preserved, augmented, and validated from preliminary design to construction and through to operations. This leads to lower risk, improved asset performance, and reduced costs.

Bentley's multi-discipline treatment plant design and analysis solution comprises plant design applications for just about any portion of the project. At the heart of the solution is OpenPlant, an intelligent 2D and 3D plant design environment based on open ISO 15926 standards and ProjectWise, enabling collaboration among distributed multi-discipline teams. Bentley's ContextCapture allows teams to quickly produce even the most challenging 3D models of existing conditions from photographs or point clouds. Highly detailed 3D reality meshes provide precise real-world context for design, construction, and subsequent operations.

One example of a project where Bentley applications were deployed is the Googong water recycling plant in New South Wales, Australia. The plant is a major component of a 6200-home Greenfield residential development. The plant’s owners wanted a design that used membrane bioreactor (MBR) technology and an integrated water cycle to reduce potable consumption by 62 percent. The technology provides the ability to meet the water demand of 18,000 residents, using the same amount of water that would serve only 6,500 people with traditional methods.

Taking advantage of Bentley’s multi-discipline treatment plant design solution, MWH Global used an integrated design approach, harnessing resources from Sydney, Melbourne, and Brisbane, Australia, as well as from Pune, India, to simultaneously deliver drawings and models with managed version control. The team used 3D modeling from concept through to detailed design to include earthwork, roads, structures, piping, and mechanical equipment.

The 3D model helped minimize risk and construction costs by providing valuable information to the construction firm, such as material take-offs, and enabled all stakeholders to identify and address operational, maintenance, construction, and design issues (such as clashes) at the 3D model review stage before beginning construction.

Meanwhile, in the United Kingdom, United Utilities turned to Bentley to ensure efficient implementation of its asset management programs. It used ProjectWise with its BS 1192 compliance to bring all parties into a connect ed data environment, allowing them to standardize data naming convention and enhance information mobility. This saved significant time that would ordinarily be dedicated to data transmission, reduced overall risk, and created a single source of truth accessible to all team members. ProjectWise allowed United Utilities to extract digital data about its assets from delivered projects and import it into corporate systems with minimal effort for complete data ownership. Owning the data from conception to commissioning combined with the ability to customize the system to enforce a data structure tailored to its business, United Utilities can more efficiently integrate new assets and soft land its projects – which is estimated to save GBP 40 million on the capital delivery program.

With its four construction delivery projects, the utility has adopted a BIM strategy, United Utilities is focusing its attention on expanding the BIM approach to obtain buy-in from asset maintenance to further facilitate efficient delivery of capital projects.

ProjectWise United Utilities already expects to reap significant savings and efficiencies on capital delivery projects, providing a truly collaborative environment to manage all digital data in a shared information model.

Water Distribution Networks

To deliver clean, potable water reliably to every customer, urban water management must understand how the network behaves, how to identify problems, and how to choose the best course of action to address the customers' and the utilities' needs. Aging infrastructure, population shifts, climate change, among other influences can change the way the system reacts to increased stress.

Bentley’s water distribution applications can help urban water organizations optimize designs, manage leaks, prioritize investments, manage energy consumption, maintain assets, enhance operational workflows, and provide predictive analytics for better decision making. Using decision-support capabilities such as hydraulic modeling and GIS, Bentley’s applications can determine the location and routing of new transmission mains, pumping stations, and storage facilities, balancing service priorities against risks and costs. OpenUtilities is a complete water and wastewater GIS that includes intelligent layout capabilities that provide real-time costing so designs can be quickly refined. Costing is based on compatible units from an organization's Work Management Systems (WMS).

OpenUtilities is fully integrated
needed to ensure ongoing quality of service. The project serves 9 million people. The project’s Water Supply System, the largest in the world, provides more than 15 percent during peak, resulting in an annual cost savings of nearly USD 1 billion. The impact of Bentley’s distribution solutions became clear in Manila. To address inefficient pump operation that led to low pressures during peak demands, but caused pipe breaks resulting from high pressure during off-peak periods, Manila Water used data logging to develop accurate demand patterns for various customer profiles in its WaterGEMS hydraulic model. It then used that same model to define optimal pump operations, balancing peak power costs with the desired pressure conditions. They reduced power consumption by nearly 5 percent during off-peak hours, and more than 15 percent during peak, resulting in an annual cost savings of approximately USD 367,000.

In another example, WaterGEMS was used to model the Cantareira Water Supply System, the largest water production system in São Paulo’s metropolitan region, which serves 9 million people. The project was undertaken to understand the current infrastructure’s potential to serve predicted population growth, identify vulnerabilities, and ensure continued operational safety as well as minimize costs and model investments needed to ensure ongoing quality of water services while minimizing environmental impacts.

Sabesp integrated field data from GIS and SCADA including historical operating information, consumptions, and registration in WaterGEMS to diagnose exceeding speeds and deficient flow rates on future consumption projections. WaterGEMS identified which pipelines to duplicate and when. With WaterGEMS, they could model necessary changes and develop an infrastructure investment pipeline for the Cantareira Water Supply System that will maximize returns and meet future needs at the right time. In addition, Sabesp was also able to optimize the operation of the pumps outside peak hours, saving electricity costs.

Wastewater Collection Networks

Population shifts can change the sources and volume of wastewater, requiring up-to-date analysis and renewed modelling based on new parameters. To stay ahead of these changes, urban water utilities must employ the most effective system planning techniques available to them.

Bentley’s SewerGEMS streamlines the modeling process so that you have more time for solving wastewater engineering problems for sanitary and combined sewer systems, such as improving capacity. Beyond just the basics of network capacity, SewerGEMS helps analyze every aspect of a system, finding obvious as well as hidden problems, and determining how to fix them. From rainfall-derived inflow and infiltration to over-flow investigations, and from hydrogen sulphide studies to pumping and energy management, SewerGEMS covers every aspect of sanitary and combined sewer infrastructure analysis. Like its counterpart WaterGEMS, SewerGEMS runs in its stand-alone platform and within ArcGIS, AutoCAD, and MicroStation and offers full interoperability with SCADA systems.

Wastewater collection and treatment also face a wide variety of uncertainties on a daily basis, from climate change to aging infrastructure and the environmental, health, and economic risks they represent.

One of the main challenges for water and wastewater service providers is keeping track of ever-changing asset conditions. Currently, many systems use Excel spreadsheets to try to connect information from different silos and software systems. This makes asset management activities and capital investment planning difficult. Instead, asset management should be embedded in the day-to-day work of operations and maintenance departments. An asset lifecycle information management (ALIM) system provides a single point of entry to consolidate inventory, inspections, interventions, and incidents. Utilities can support many cross-discipline workflows for operations and maintenance, obtain reports on the biographies of a single asset, or a category of assets defined by area, installation date or other definitions, and track the “as-maintained” state of the network. This provides insights into why some assets or areas of the network outperform others, are costly to run, deteriorate at a faster rate, or exhibit higher risk to the organization. Thus, ALIM provides utilities with a compelling decision support platform.

Wastewater Treatment

The water treatment consideration and solutions discussed above also apply to treating wastewater re-entering the system. Once again, BIM and digital engineering models play an important role, one critical for information flow from planning and engineering through plant construction and operations.

The digital engineering model delivered from the capital project phase becomes the backbone of an information management strategy. Being able to compare the “as-operated” asset with the digital asset held in information management systems enables operators to make better decisions when planning maintenance, in operating assets, and developing both strategic and tactical asset management plans. The need to manage and effectively utilize data and information collected during the entire lifetime of an asset is at the heart of Bentley’s AssetWise. All aspects of the treatment plant assets and conditions are subject to varying degrees and rates of change.

To implement maintenance strategies for predictive, preventive, or condition-based activities, wastewater engineers need visibility into comprehensive real-time engineering information at any moment. By integrating with Bentley’s AssetWise capabilities for asset lifecycle information management and reliability, the up-to-date accurate digital engineering model is complemented with detailed asset information. It is then available to engineers, contractors, and maintenance professionals to support plant operations and maintenance activities such as responding to emergencies, performing maintenance planning and execution, shutdown, inspection, compliance and reporting.

Advancing Management of Urban Water Infrastructure

The water infrastructure lifecycle begins with the planning and design of the assets required to operate the urban water network. Capital expenditures (CAPEX) to build new infrastructure may be driven by data, collected, and used in modeling to predict and understand the performance of each asset involved in water and wastewater networks and treatment plants. Operational expenditures (OPEX) should also be data-driven in order to make informed decisions about the maintenance of urban water infrastructure. Asset performance software and strategies can be used to ensure dependable operations in all conditions, and reduce the total mone tary expenditures (TOTEX) across capital investment and operations.

In each phase of the water lifecycle, software plays a key role in facilitating decision making about new and existing infrastructure, determining the viability of legacy systems, and optimizing the construction of new networks and treatment plants. BIM, hydraulic modeling, GIS, asset management, and reality modeling all serve as critically important solutions in making certain that investment in urban water infrastructure is spent wisely and effectively and that the systems will be in place for decades.

As a solutions provider to the urban water industry, Bentley brings together the capital and operational aspects of managing urban water infrastructure to realize gains on all sides. Bentley’s solutions span every step in the lifecycle, including planning, design, construction, and operations, and management with the information they need to implement the strongest asset performance strategies.

About the Author

Cyndi Smith is the Senior Industry Marketing Director at Bentley Systems.

Bentley is dedicated to providing engineers, architects, geospatial professionals, constructors, and owner-operators with comprehensive software solutions for advancing infrastructure. Founded in 1984, Bentley has more than 3,500 colleagues in over 50 countries and is on track to surpass an annual revenue run rate of USD 700 million during 2018. Since 2012, Bentley has invested more than USD 1 billion in research, development, and acquisitions.
Hydrodiplomacy and Addressing Water Security: Lessons from 40 Years of Experience

Prof. András Szöllösi-Nagy is one of the most recognized names in international water management. Currently, he is a professor of Sustainable Water Management at the National University of Public Service in Hungary and serves as Chair of the Intergovernmental Council of IHP. Over the past 40 years, he has been instrumental in the shaping both institutions and approaches to freshwater management.

By Karen Delfau, IWC for the Australian Water Partnership (AWP)

Q. Tell us about the World Water Assessment Programme.

Prof. András: The idea of having a World Water Assessment Programme began back in 1992 at the United Nations Conference on Environment and Development - the Earth Summit at Rio de Janeiro. That was a milestone time in environmental affairs. It was when the first climate agreement was signed, known as ‘Agenda 21’. Lots of new things were opening up. The governments agreed that in five years’ time they would have a look at the progress made.

So in 1997, the General Assembly of the United Nations examined the various recommendations arising from the work of the previous five years, and how much progress had been made, and they came to the conclusion that water was, by and large, a forgotten commodity. That was the first time the UN General Assembly adopted a resolution, and it said that unless you understand that, you run the risk that major uncertainty will develop and perhaps water will become an important issue.

Therefore, the UN General Assembly invited the UN System to come up with a regular assessment of the resource. That was in 1997. Nothing happened for two years, because nobody had the money. Then, I remember, we were down in Beirut in Lebanon, at one of the annual meetings of the UN Water Directors, and I suggested that perhaps we should do, as the UN, a comprehensive assessment on how water and various sectors of the socioeconomic system are interconnected. And perhaps we should develop indicators to measure the degree of this interconnectedness: for instance, how water and disasters are interconnected; how water and public health; how water and food security; how water and energy security; how water and climate variability are interconnected. We could measure that linkage between the two sectors, water and other parts of the socioeconomic system, by a set of indicators which lie between zero and one. And that would give the political community and the policymaking community some idea of where potential problems lay and where investment was needed. It might be political investments in terms of implementing negotiations, for instance over the transfer of resources, or financial investment to build sustainable plans, or whatever was needed.

I argued that no UN agency can do this job alone. But nobody else can do it except the UN System bodies...
Q. How does the World Water Assessment Programme lead to action on-ground?

Prof. András: That happens via the World Water Forum series, which is still continuing, run by the World Water Council, which is an NGO. When the various players come together at these forums, we can say things that would not be heard if said by just one person. The next World Water Forum is in March 2018 in Brasilia. It is a huge gathering - 30,000 people. The forum is very effective in bringing together the stakeholders. Scientists are able to connect there to not only the political players but also to the public that we are supposed to serve.

While I'm very proud of the World Water Assessment Programme, there are ups and downs and we are now revitalizing it with a new initiative, ‘Water Futures’, which is a part of the major program called Future Earth.

Future Earth explores where we are heading: What’s going to happen? Is it really true that if you go at the same pace, in 80 or 90 years’ time our systems will collapse because of population pressure and climate change impacts?

We have the tools. You may have heard of ‘Water Futures’. It is a program run from Brisbane with nearly 6000 scientists around the world who are working on building up a global model of the water circulation. That is a large amount of data to deal with, from a system that covers the whole globe, with observation data every 500 meters. Of course, those observation data are not ground observations but derived from earth observation systems: satellites and remote sensing.

Over the last ten years or so, computational capabilities have improved so much that now we can compute anything; and we can observe almost anything with satellite systems and remote observations. The combination of the two, and digitalization, means the connected, the computable, the context, the scale and the telling of the story. Is there a need for this? Is going to be a leap forward.

These days we are seeing the emergence of digital water management, and capacity to work at different scales. Formerly our scale of the operation was large, planetary, and we used global circulation models to see how the atmosphere is changing and how the climate is changing and forecast the impacts of those on the hydrological cycle. Even ten years ago, the spatial distance between two computational points would be more like 500 kilometers than it is today. Now the points are only 500 meters apart, and that’s because of digital technology. At the planetary scale, you are considering the huge movements of water masses. The other end is the microscale: for example, how you operate a sewage treatment plant and model the water quality of a pond or a lake, and what sort of cultural barriers you have to leap to improve the water quality of small water bodies such as those we have around us day to day.

There’s a huge gap between the two scales, and there are 50 shades of grey in between, and how do you jump from one scale to the other? In other words, how do you integrate the systems of various time and space scales into one whole? With the emerging Internet of Things we now hope that in five to ten years’ time the bio-geo-chemical systems, physical systems, social systems, will be all connected, and we will see how these interact.

We need this, because if you look ahead, not far, just 32 years, we expect to have nine billion human beings. The current world population will be living in cities – and the major issue there will be water.

Recently, Anik Blahduri, who is the Executive Director of the Sustainable Water Future Programme in Australia, and I were in Bengaluru, and I met with the Bengaluru Water Authority, which is called now, which is one of the capitals of the Indian IT industry. Take that as an example. The population has grown immensely and there are ten million people living in Bengaluru now. However, the groundwater table has dropped more than 500 meters, and they no longer have access to it. But in 30 years, Bengaluru will be a city of 31 million human beings. That will be a totally new ballgame in terms of how people communicate with one another, and how social security and water security are implemented for that size population. It is going to be a tall order to provide enough water for the people. We are moving in that direction now using digital water management, integrated water management, integrating social, economic and environmental aspects.

Q. Can we have your thoughts about water governance?

Prof. András: The question which I am always asked by politicians or the public is: Is it true that we are running out of water? Well partially, but never fully, because the hydrological cycle is a renewing cycle. But if you look at the past 35 years, the drop in water availability was indeed dramatic globally. Some 35 years ago, grossly, on average, there were 15,000 cubic meters of water available per person, per year. Today it is down to 5000: not because we have overused the resource, which is also true, but because of the increasing number of users, a triple exponentially increasing number of users. How do we meet that situation? Everybody says, ‘Oh yeah, there is the sea, and we do desalination’.

Really, a solution for water security requires us to think over how we govern water resources. How do we do it? What sort of institutions have to deal with it? Part of the answer is integrated water management.

That is why lately the issue of water governance has surfaced, where you ask yourself the question: What are the right things to do? Note the difference from water management, where you ask yourself the question: How can we do things right? Those questions are not exactly the same.

There are considerations in water governance that go far beyond water availability and forecasting and management. Some of these considerations include:

• How to share, particularly in a trans-boundary context, educational issues
• Research issues
• Corruption – how do we minimize corruption?
• The rule of law in water management

These kinds of issues were always present, but the water management community by and large avoided those big questions. They require a different kind of knowledge than, say, engineering. These are the big issues that water governance focuses on.

The next World Water Forum, in Brasilia, will be devoted to sharing water. So here is the contradiction. On the one hand, you have a finite resource which is exactly the same today as at the beginning, though the number of users has triple exponentially grown since the industrial revolution. Of course, as a net result of that, water available has triple exponentially reduced. How do we resolve that conflict?

If you look at climate data and climate change, roughly 80% of climate change, or more, will be manifested through, with and by water. Probably at the global scale, the hydrological cycle will accelerate. If that is the case, then the probability of the extremes will increase, which means that we will have more frequent flooding, and they will be larger floods. But in order to keep the first law of thermodynamics, or continuity (in other words), at work, we can expect there also to be a negative side to the changes: namely, more or worse droughts, all of them with their spatial extent and duration. At the same time, the amount of water will be the same. These are not far off processes, these
are processes which are probably already observed and are highly likely by the end of this century.

A concern for water governance is climate change mitigation, and that is the essence of the Paris Agreement, to keep the global average temperature increase to less than two degrees centigrade. The reason why we need to do that is because if the temperature increases beyond two degrees then perhaps it will set off irreversible processes in terms of the acceleration of the hydrological cycle. That's the bad news.

**Q. How can people in the water sector be more effective in addressing some of these global challenges in the future?**

Prof. András: I think we are moving in the right direction in that regard. We have to increase our knowledge base, not only on the availability of water but also on how people are related to water.

In Europe, what we may refer to as ‘water culture’ has gone. If you ask an average European ‘Where does the water come from?’, their response is: ‘From the tap’. They take it for granted. But that obviously is wrong.

The Africans still have an extremely powerful water culture, based more on anthropological than natural sciences. They look at water totally differently, and that is why, for instance, Africa shows a very positive attitude to transboundary cooperation.

In other parts of the world, upstream and downstream countries are at each other's throats over how to share water. Around 4 billion people - 40% of humanity - actually live in transboundary basins. Some upstream countries consider water to be their property and they insist upon absolute sovereignty over resources, and they say to the downstream countries: ‘It is none of your business how I use my water resources on my territory’. And that is a source of conflict.

Now, in conflict management, you often ask the parties to look at the source of conflict from different angles, so that they begin to see a different picture. Joint vision-building is very important, and we now hope to develop tools to enable that. These are organization support tools, mathematical computer models. We need to know how to build those models in a process which helps confidence building, so the parties trust each other.

Without water sharing, what will be the impact on the environment, ecosystems, the groundwater tables of downstream countries? Up to now, transboundary water issues have generally meant two parties fighting one another. What we need to move towards is two (or more) parties cooperating with one another. There's no other way.

Another big challenge is lack of access to water and sanitation. It’s not a rosy picture at all. At the end of the Millennium Development Goals (MDG) period, after 15 years of investing heavily into water supply systems, the former UN Secretary-General, Ban Ki-Moon declared that we had reached the water supply goal. Its principal objective was to halve the number of people living under absolute poverty, including access to water, compared to the beginning of this century. How 1.4 billion people had no access to water. And in certain parts of the world, thanks to the policies of China and India, there has been tremendous progress.

I’m pretty much hopeful that we will get there. Essentially, it all depends on the governments. Principally the issue which was missing before was political will, and now it seems that the political community recognizes that they have forgotten about water and that we must do something about it.

For instance, the Secretary-General of the UN and the President of the World Bank have created a very high-level panel consisting of heads of states, to come up with proposals on the financing of water projects. So things are moving on the political front, which is good news. In principle it is doable. Now we need to forge closer relations between the various parties - the scientists, the decision makers and the practitioners - and for them to stop operating in silos.

Some big countries still don’t recognize what water security is. Some of them, until recently, declared that security is a military concept, not understanding that water security is not the same as being able to walk at night without being mugged. Water security is security against the vagaries of water: low flow, high flow, high water quality and all the rest of it. Luckily the UNESCO international agricultural program has a definition that describes what water security is all about. I remember chairing a political process of the World Water Forum in which the world’s water ministers come together and we try to build their understanding and consensus around the big issues that are ahead, and potential solutions. One issue was the notion of water security. What broke the ice was when those governments were confronted with the UNESCO definition, and told an intergovernmental program with an intergovernmental negotiation had adopted this resolution.

**Q. Is there enough water if we use it wisely?**

Prof. András: Yes, we have enough water, never mind these Doomsday people who say, ‘We’re going to be all killed because there is no water left’. There is a huge amount of water, with 90% of it under the ground. But groundwater resources are extremely vulnerable and once they are polluted then we are up with proposals on millions until the sub-purification process takes its effect. In contrast to surface waters, there is no technology that can be applied to purify water at a mass scale. Think of a large aquifer such as the Nubian Sandstone Aquifer under the Sahara. It is the biggest amount of water that we have in the world, but it’s fossilized water, so using it is effectively mining it. The more you pump out for people, the lower the elevation of the groundwater table. That is happening in Beijing for example. The Chinese are transferring Yangtze River water to Beijing, not just for fun. They have two options: either they take Beijing to the Yangtze River where there is a good flow, or they take the Yangtze waters to Beijing, where there are the more people. They’ve opted for the latter, because Beijing became almost unliveable in terms of water availability, and that is a huge issue.

**Q. Please tell us briefly about the High-Level Panels on Water.**

Prof. András: Currently, there are three separate High Level Panels, although they communicate. Earlier I mentioned the High Level Panel of Heads of States. The Presidents of Mauritius and Mexico are leading a panel of some 10 presidents, including the President of Hungary. This panel is dealing with financing issues - such as by setting up a fund, or a global water bank - to help developing countries finance their problems. There's another High Level Panel on Water and Disasters. South East Asia is the region most affected by water disasters, particularly in terms of flooding. The Japanese and the Koreans are very sensitive about it, so they are working on recommendations for disaster management, based on a previous UN document, the Sendai Framework, and others. These two panels are still at work.

The third panel is called the Global High Level Panel on Water and Peace. I was on it as a scientist. It’s a 15-member panel led by the former Slovenian President, Danilo Türk, and it includes a couple of Prime Ministers, a few Environmental Ministers, a French General who was involved in the French Army water supply operations and understands the protection of critical water infrastructure against terrorism and in war situations. That panel has completed its work. It produced a 100-page volume which contains a set of recommendations; you can find it by googling ‘A Matter of Survival’. The recommendations are rather strong in relation to transboundary cooperation, and in terms of having access during military skirmishes and wars. Water can be used as a weapon, for instance, by building reservoirs or water supply networks. The volume looks at some very fundamental questions that had not really been looked at by the engineering community. It’s quite an interesting report. Among its major recommendations are: Don’t weaponize water; water is a peace builder; consider the role of data; transboundary data should be openly accessible, or databases ought to be opened up.

The report I mentioned is dealing with transboundary water cooperation, diplomatic approaches, strengthening the knowledge base, and data-driven decisions with open access databases.

**Q. Is there anything else you'd like to share with us?**

Prof. András: I would like to leave on an optimistic note: namely, that water should not be a source of conflict. Instead, it is a potential source of cooperation, and that’s how negotiation tools in the foreign ministries ought to be developed. There needs to be a new whole subject called Water Diplomacy.

**The Australian Water Partnership (AWP) is an Australian Government development project enhancing the sustainable management of water across the Indo-Pacific.**
Water Security: Threats and the Way Out

The population growth, at almost 80 million a year since 1992, is one major reason for heightening water scarcity or worsening water security.

By Shikhar Sharma

What is Water Security?

Water Security has for long been seen from the perspective of humans only. However, the environmental concerns are now taken into consideration to define this term. Global Water Partnership states that “Water security, at any level from the household to the global, means that every person has access to enough safe water at an affordable cost to lead a clean, healthy and productive life while ensuring that natural environment is protected and enhanced”. Due to various reasons like rising pollution, population and climate change, the availability of water is depleting not only for humans but also for the environment itself.

Many developed nations have managed to bring the water quality of their rivers to appropriate levels harmonizing with nature and affecting the ecosystem the minimum. However, most developing and under-developed nations still struggle to do so. It is estimated that by 2025 almost fifty percent of the world population shall be living in the areas facing severe water shortage, much to cause the food shortage.

The escalating human population has led to an elevation in the demand for water for human consumption directly and indirectly. The rapid industrialization and urbanization after the industrial revolution have also resulted in worsening climate changes which are apparently other than the natural ones.

Factors Affecting Water Security

The population growth, at almost 80 million a year since 1992, is one major reason for heightening water scarcity or worsening water security.

The demand for water for the day-to-day needs like drinking, cooking, washing, and bathing is increasing. The escalating food requirements are increasing the need for the agricultural water. Shortage of food supplies in South Asia and sub-Saharan Africa are the examples of food security affected due to water scarcity. In order to suffice the daily needs and to provide a quality life, the number of industries is expected to grow. The industrial consumption of water, thus, shall also elevate. The quantity of wastewater generated (domestic and industrial) is also expected to increase. Since most countries are not able to grow the wastewater treatment facilities at the needed pace, the untreated or partially treated waste is rejected and discharged into the rivers. This causes water quality deterioration and can affect an ecosystem. Higher industrialization and urbanization is causing environmental pollution which in turn is causing climate changes.

The anthropogenic climate change is, today, considered to be a major predator of the balanced ecosystems. Emission of large quantities of greenhouse gases has resulted in an increase in temperature globally. Many experts argue that the rising temperature is a natural trend. However, the unprecedented rate of the rise is recognized by all. The elevated temperature has been causing glacial melting, which has severe effects on the water in rivers as well as in the sea. The sea levels are rising world over. Most of the coastal mangrove forests of the world have been flooded.

Costs of Not Taking Action

Increased Water scarcity has forced people to extract groundwater, lowering the water tables. This is causing seawater ingression in places like Bangladesh. Altered water availability is expected to lead to population displacement, agricultural and fishing losses, disease outbreaks, and conflicts that could become violent and spill over state boundaries.

The glacial retreat is expected to reduce the flow in perennial rivers and convert them into seasonal. Global warming is estimated to change the rainfall and other seasonal patterns thereby causing floods in some areas and droughts in others.

The pollution of river water is not only killing the organisms lowest in the food chain but is also causing poisoning in the predators in the top of the food chain. Due to lower population, these predators are usually unable to develop immunity against such impacts and become susceptible to be annihilated from the area. In absence
of the predators, the organism lower in food chain goes unchecked and may increase in number. Excessive grazing by such animals can result in the alteration of terrains like the desertification when combined with lowering water tables.

It can, thus, be said that increasing population and climate change are the barriers in the way of water security for the mankind. The importance of water security lies in the fact that any compromise with it can have consequences on food, political, social and ecological security!

How Can it be Achieved?

Strong and strict steps are required to ensure growth in harmony with nature and to restore freshwater resources to avoid the life-giving water transforming into a vector of diseases for man and his environment, both biological and social.

Ensuring water security in every part of the world needs to be the primary target of the governments world over. A model of sustainable growth is required wherein all the economies shall go hand in hand. A keen focus on following points should pave the path.

• Population Control: The first target is to adopt sufficient measures to retard the rate at which the mankind is growing world over.
• Use of Alternate Sources of Freshwater: As population and water demand have grown, man-made infrastructure became necessary to supplement natural assets in order to maintain water security.
• Integrated approach for total environmental management is essential. Proper management practices integrating land, water, and ecosystem as a whole, giving due regard to sustainable growth, should be adopted.
• Policies and Regulations Need Revision: "new water policies must reflect the fact that no policy can be implemented solely by professionals and official agencies. The involvement of users and affected interest groups is important for a variety of reasons."

The Scene in India
India’s Water demand in 2030 is estimated at around 1.5 trillion cubic meters, almost double of present value. In 2006, the per capita water availability in India was 1730 m3/year, which shall dip to 1240 m3/year in 2030, making India water scarce, serious efforts are required to deal with the situation.

Majority of India’s water demand is catered by the basin of river Ganga which has a catchment area of 1,080,000 km2 across Nepal, India, and Bangladesh. 80% of the area of river Ganga basin lies in India. The giant river is 2525 km in length and houses a population of 370.2 million people with a density of 550 people per square kilometer. The basin covers almost 26% of the total geographical area of the country and provides residence to 45% of the population. It boasts a net irrigated area of 22.41 Mha which is approximately 43% of the net irrigated area of the entire country. 63% of its irrigated area is fed by the groundwater.

The river provides 525 km3/yr of water to India. While 17.52% of the total hydropower potential of this basin has already been harnessed, another 12.77% shall soon be tapped as part of future plans.

The river holds a spiritual and religious significance for the nation. Ganga has been symbolic of purity and peace and is respected as a mother by most Indians. The divine mother is believed to absorb all the sins and cleanse its children of the negativity. The river has lived up to the belief for ages, but the negativity of pollution has seemingly started to take a toll on it now. The man’s exploitation of nature has affected the messenger of purity. Recognizing its importance to the people and the role it plays in the economy and goodwill of the country and its people, the river was declared the National River by the Government of India in 2008.

The major cities on the banks are Haridwar, Hardidwar, Kanpur, Allahabad, Varanasi, Patna and Kolkata. These cities are the tourist or industrial centers and have been growing at a rather fast pace. The increasing population pressure has lead to overexploitation of the entire river system. The reduction in Ganges discharge in 25 years has caused 50% drop in water availability on the surface, and from groundwater table and this may, in long-term result in the creation of new surface features having different thermal properties. The Gangotri glacier is retreating at an alarming rate of 28 meters a year.

The major causes of the problems confronting the river today have been identified as follows:

• Over-withdrawal of fresh water from the basin.
• Discharge of pollutants into terrestrial and aquatic environments.
• Reduction in water-holding capacities and replenishment rates of water bodies.
• Mutilation of rivers by piecemeal engineering operations.
• Changes in geological factors governing the basin.

Water Security in River Ganga Basin

The issue of Water Security in River Ganga basin is of great importance for the Indian people and growing economy. Though the majority of the river basin lies within the boundaries of India, the Ganga’s waters are shared by India with Nepal, Bhutan, and Bangladesh. As a result, analysis and management of basin become a tricky task as the availability of data is very limited. This also puts a restriction on public participation. Easier access to the water-related data for the rivers shall lead to better and detailed analysis, attracting more public participation. This shall also give a sense of ownership of the river to the public which will attract a responsibility to keep the river and the environment clean.

The water has been a reason for tensions between nations. There are examples where neighboring nations have been able to better manage the river basins ensuring collateral development by helping each other in managing the river basins by adopting the practices of Integrated Catchment Management. European Union is a good example. Evidently, better sharing of data between India and Bangladesh has successfully eased the political tensions in last few decades, this also gives both the nations the joy of joint ownership of the river. Integrated catchment management shall help all the stakeholders to grow sustainably in the future.

Towards ‘Water-Secure’ Future

In order to ensure the water security and sustainable development of the Ganga basin and the entire country, there is a need for the development of expertise in the field as highlighted by the National Water Policy, 2012. The international community has been a pool of expertise for guiding the development of various parts of the world. The success of GAP was assisted by the support from India’s technological partnership with the UK and Netherlands. The Anglo-Indian projects have yielded great results in past.

Australian Water Partnership with India is another way by which the progress is being made. Similar initiatives shall pave way for a future enlightened with much-needed expertise that can cater to the need of a growing nation.

Public participation is by far the most important aspect in bringing about changes. There is a need to create awareness among masses about the importance of water, rivers, and conservation of the environment.

Further, the modern practices of integrated catchment management, that has proved itself in various parts of the world, maybe a way forward for India.

History has been a witness of political will proving to be a driver of change. The augmenting political scenario in India promises to continue the ascendant journey of the national economy while preserving the tradition of fostering the nature.

About the Author
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Policy and Technology Challenges in Managing Water Supply and Consumption in India

By Amrita Chowdhury

Comparing rivers, it estimates that less than 5 percent of the water of the Brahmaputra is usable, due to topographical challenges. In contrast, a significant fraction of the waters of the Ganga, and a large fraction of the waters of Godavari, Krishna, Indus, Narmada, and Cauvery are usable.

Groundwater: An analysis paper published in the Journal of Earth Science System in 2008 posited that groundwater availability was even lower than estimated by policymakers. Research conducted subsequently by Indian Institute of Science (IISc) and Indian Space Research Organization (ISRO) verified this position and further found that loss of water through evapotranspiration equaled or exceeded its replenishment through annual rainfall in northern states and the Indo-Gangetic plains. A McKinsey report published in 2009 suggested that India will only be able to meet half of its water requirements by 2050.

Rainfall: India relies heavily on monsoons to replenish its aquifers and water bodies. While there is great media focus on monsoonal rains, which influence short-term cropping patterns and efficiencies, there are several other factors influencing long-term availability of ground and surface water, even when rainfall is adequate.

Factors Impacting Water Availability

Rapid urbanization and poor regulatory norms have led to excessive pumping of groundwater. Gurgaon is held up as a case in point, but similar scenarios exist in high density, high rise, high-end enclaves around the country, and even semi-urban areas in water-deficient states. Large-scale deforestation has led to the reduction in moisture in the air and an increase in ambient temperature, further increasing ambient water loss. Air quality pollution can influence the pattern of trade winds and monsoonal rains. Government subsidies and incentives have encouraged farmers to shift to water-intensive crops in water-deficit states, severely affecting the availability of water. This includes practices such as growing rice in Punjab or sugarcane in Maharashtra.

Water sharing agreements have been put in place globally to manage water flows across geographies and national boundaries. India shares its water from rivers that originate in neighboring states. But this situation is affected by geopolitical sensitivity and questions around water flow and quality data.

Furthermore, improper disposal of sewage, industrial waste, and chemicals run off from farms has contaminated India’s water systems and rivers and reduced access to clean water for domestic, drinking and industrial usage. Lower availability of water has a further downstream effect on quality of life indicators such as hygiene, sanitation, and prevalence of water-borne diseases. In fact, the water project suggests that creating access to safe and clean water leads to improvements in economic outcomes of a nation.

Defining India’s Water Consumption Challenges

India’s water predicament is further influenced by its unique consumption patterns, leakage and loss patterns, wasteful consumption behaviors and regulatory policies that do not reflect the criticality of the challenge. India has traditionally focused on increasing water supply. However, Indian utilities lose roughly 40-60% of their water compared with 37% loss in Tokyo and 7% loss in Phnom Penh. Estimates from the third world center for water management indicate that less than 10% of wastewater generated in India is treated and recycled.

Consumption Patterns: India’s water consumption patterns are uniquely different from developed markets. Agriculture accounts for highest water usage, largely because most farmers still use flow irrigation rather than advanced, water efficient practices such as drip irrigation. Lack of regulatory incentives for agricultural water conservation leads to greater inefficiencies and water wastage. Europe consumes 33% of water for agriculture, 54% for industry and 13% for domestic usage. Central Water Commission reports suggest that over 85% of water in India is used for agriculture. Clearly, just increasing supply is not the answer. Shifting consumption patterns and reducing inefficient use of water will be key.

Central Water Commission reports suggest that mere 7-8% for domestic consumption, and the rest for the industry, energy, and other uses. It projects that the usage of water by agriculture will decline marginally by 2050, with most of this being used for energy generation. The predicted usage of water is set to increase across every sector, with a disproportional increase in industrial and domestic usage as urbanization happens and population and affordability increase. While the per capita consumption of water in the United States is projected to decrease by 2050, the per capita consumption of water in India is set to increase substantially. India already consumes a lot more water than the USA and China, and our per capita consumption of water is slightly lower than China currently. As India becomes the most populous country in the world, its requirements for water will increase further.

Infrastructure and Distribution: Indian utilities spend on water infrastructure has lagged. There is incomplete coverage. Only 49% of Indian household have access to the formal water distribution network and piped water supply. Poor infrastructure, older technologies, and aging systems have led to ineffective management of water.

Non-revenue water rate, due to theft or loss, stands at 41% in India compared with 21% in China. It is significantly higher than the global average. This has led to the proliferation of informal water net-
works and costlier water supply options. Asian Development Bank’s 2004 report estimated that Delhi had 50% non-revenue water, whereas Dhaka at 40% and Hong Kong at 25% showed better water security. In contrast, Delhi had 32% metered connections and 19.9 staff per 1000 connections, compared with 50% metered connections and 11.6 staff per 1000 meters in Dhaka and 100% metered connections and 2.3 staff per 1000 connections in Hong Kong.

Clearly, lack of metering and manual infrastructure leads to poor water outcomes. In contrast, in 2004, Chengdu in China was making one of the highest capital investments in water and showed 18% non-revenue water; 98.5% metered connections, and employed a large force to manage distribution and collections with 33.8 staff per 1000 connections.

In recent times, City Reports published by Ujjain Municipal Corporation, for example, estimates that 25% of its water supply gets lost during distribution and transmission stages. Physical losses due to leakage and illegal connections account for most of these losses. A smaller fraction is lost due to unbillable consumption or other reasons.

Critical Imperatives to Solve India’s Water Shortage

India requires a comprehensive water management approach, from better management of watersheds and rainwater harvesting to improve supply side to water monitoring, wastewater recycling and usage led behavior change on the supply side. There are key imperatives for the government at the central, state and city levels as well as for each category of users.

While programs such the ambitious US$ 150 Billion Involving Brian’s (ILB) by the National Water Development Agency (NWDA) to interconnect 30 rivers through 15,000 km of new canals can also have unanticipated ecological effects, easier solutions such as rainwater harvesting at the city level can improve supplies.

The demand for water is fast outpacing supply and the situation will only worsen. Hence India needs to focus more on managing demand to reduce water shortage.

• Given that agriculture consumes over 80% of available water supply, the government should create incentives for efficient water management and mandate consumption monitoring.

• While agricultural subsidy management may be a contentious and political issue, key investments can significantly improve infrastructure, availability, efficiency and revenue generation in urban water distribution.

• Investments and incentives to build wastewater and sewage treatment infrastructure and increase adoption.

• Regulatory changes to create consumption linked tariffs for domestic and commercial establishments in conjunction with smart metering initiatives to encourage judicious use of water and monitor for losses and theft.

Using Technology Enabled Smart Metering Solution

In Systems Thinking approach, monitoring and minimizing water consumption at the household or commercial establishment level may be a small fraction of the overall water requirements for the country, however, it can have a disproportionate impact on the availability of water in urban areas.

Recent government initiatives are encouraging researchers and practitioners to use Artificial Intelligence, satellite and groundwater data imagery to map more accurately, easier solutions of India’s water availability or map the pollution and contamination levels in rivers and lakes. Massive investments were allocated for the Namami Gange project, however detailed project and impact reports are needed to understand the progress.

However, given that roughly 40% of available domestic water is lost due to illegal connections and another 40% lost due to leakages and wastage, huge changes can be made by simply focusing on metering. Ensuring complete coverage of metered connections, especially smart meters that give granular information on consumption and losses, is an easier change.

Sensor-enabled smart metering infrastructure can enable cities and utility service providers to monitor and manage water supplies at the distribution level, as well as monitor and manage water consumption at the building level. Changes in regulation will be needed to create incentives for measuring water consumption at the household level. The end to end, source to user solution encompasses pipes infrastructure, smart meters, communications platforms, data aggregation and visualization platforms. Aggregating and visualizing data across households, buildings, wards, or cities will allow administrators to identify patterns, monitor consumption, and track losses.

Using Automated Metering Infrastructure (AMI) solutions, water service providers and utilities can measure real-time consumption data on daily basis. This data offers providers visibility into usage patterns by ward, locality, building or consumer type and help them understand consumption patterns by day, time, month or season. Providers could integrate automated billing and payments systems, offer online records, and improve the efficiency and cost of their operations. Furthermore, this data can be used to manage and detect illegal, wasteful and misuse consumption, create usage-based tariff structures at the building or house level, identify leaks or losses, and enable measurements driven behavior change to prevent wasteful usage.

Even without the regulatory change of allowing water to be chargeable at individual household level in buildings and housing societies, AMI technology can offer transparency and visibility. However, in longer run, water regulation and taxing policies will need to be revisited.

While India has seen a handful of pilots of Automated Meter Reading (AMR) technology, it does not offer the deeper benefits of real-time data and thus dynamic optimization that will be required over the coming years. The country needs to leapfrog into the next generation of AMI technology. Under the Smart Cities Mission and additional funding available through the AMRUT program, cities will be able to access funds for the much-needed water infrastructure improvements.

Using Policy to Direct Water Consumption

The real challenge in water is the lack of regulation and the ability to monitor misuses, wastage, or illegal consumption. Both create inappropriate behaviors that further exacerbate an already critical problem. Regulatory changes are needed on many fronts to address this. Demand for water is expected to rise in the coming decades, and supply will remain constrained. Hence, it is critical to manage the demand-side parameters to create incentives for conservation and charge based on actual consumption.

Firstly, farm water regulation and tariffs can influence behavior on conservation and need-based usage. Easy technologies like remote switching off or timer based switching off of irrigation pumps or drip irrigation methods can reduce water wastage. But lack of regulation or tariffs create disincentives for deploying such technologies.

Secondly, commercial usage of water can be regulated and monitored, encouraging them to use grey water sources and reduce leakage.

Surat Municipal Corporation recently deployed smart metering solutions in commercial establishments, along with other water distribution and management strategies, to reduce consumption.

Thirdly, policy directives should influence municipal decision makers to better deploy the funds available under AMRUT, for greater metering of cities. Consumption tariffs were introduced in electricity a while back. However, water is charged at the building level based on the size of homes or flats, rather than actual consumption. Again, this does not create incentives for citizens and homeowners to regulate consumption and wastage. In contrast, many parts of many cities do not get 24/7 water and require tank water substitution to meet their needs.

Conclusion

Water availability is fast becoming the most critical challenge of our times. It affects farmers, businesses, and citizens - and the acute shortage is being felt by every citizen from every walk of life. India needs to focus attention on both supply-side measures and demand-side measures. It may need to create the intent, commitment and processes to enable early wins - such as mandatory water harvesting, wastewater recycling, and automated metering infrastructure solutions - to create a platform on which larger reforms and high budget, high impact initiatives can be built.

It needs to consider a partnership approach - between cities and water service providers, between water service providers and real estate developers, and between cities and citizens - to ensure the success of this effort.

About the Author

Amrita Choudhury is the Director of Gaia, a smart feed back and automation firm focused on Human-to-Machine and Machine-to-Machine data acquisition and analytics.
European Swimming Pool Water Treatment Systems Market

By Frost & Sullivan

The European Swimming pool water treatment has achieved tremendous growth during the recent years due to increased awareness of pool water quality. Various technological advances in the pool water treatment have gradually transformed the industry but media based filtration and chlorine-based disinfection continue to dominate the pool water treatment market due to its cost-effectiveness.

The two main components of a swimming pool water treatment cycle are filtration and disinfection, which lead to a key challenge of high operation and maintenance needs. Pool water must be filtered and disinfected before use and recirculated for treatment based on usage. Apart from cleaning swimming pool water, special efforts should be taken to prevent bio-film growth or algae from collecting on the pool’s floor or walls. Maintaining the correct pool water chemistry is also critical. The water should have a neutral pH, and residual chlorine levels should be maintained for continuous disinfection. Improper swimming pool water treatment maintenance can lead to serious health implications. Most European countries have regulatory standards for swimming pool water treatment, which specifies the level of residual chlorine to be used for disinfection, the number of recirculation cycles based on the pool usage, and other chemical parameters. Currently, technological advances are being made to reduce the use of chemicals and their by-products.

The efficiency of the filtration directly affects the chemical consumption. Disinfection by-products have proven to be detrimental to human health. Lack of efficiency and biofouling has constantly plagued the sand filter media which in turn increases chemical consumption and subsequently escalates the overall operation cost.

Smart and Sustainable solutions are in high demand by the customer as it helps to reduce energy and chemical consumption and also improve water conservation which in turn is cost effective and reduces labor.

Key Disruptive Technologies & Solutions

Glass Based Filter Media

Dryden Aqua pioneered the development and launch of AFM® (Activated Filter Media) which is a direct replacement of sand media filtration. It doubles the performance and reduces chemical consumption. Based on AFM® media Dryden Aqua has developed and launched an integrated pool water treatment system called Dryden Daisy®. The activated filter media is made from recycled crushed green and brown glass. It undergoes a 3 step activation process that provides a highly catalytic surface area. As a result, the surface area is more than 300 times greater than sand media which helps in doubling the performance of the filtration. The metal oxides, in the green and brown glass pieces, helps in producing a negative charge that attracts the heavy metals and organic particles thus making the AFM self-sterilizing and thus prevents biofouling.

AFM has also been independently tested by IFTS Institut de la Filtration et des Techniques Séparatives in France which is the leading swimming pool water treatment market in Europe. AFM's performance was tested against quartz sand filter and other glass-based media filters. The test results further highlighted AFM media’s superior performance than quartz sand filter and any other glass-based media.

Robotic Pool Cleaners

Robotic pool cleaners have disrupted the swimming pool water treatment. The robotic pool cleaners clean the surface floors, walls and water lines of the swimming pools. This helps in the removal of debris or any other solids settled at the bottom. It also helps in removing the algal growth and biofilm growth. The use of robotic pool cleaners improves the efficiency of the filtration unit and helps in reduction of the chemicals used for disinfection.

Maytronics has pioneered the development of Robotic pool cleaners since 1983 and it is one of the global market leaders for robotic pool cleaners. The pool cleaners are eco-friendly, plug & play model. All Maytronics pool cleaners operate independently, it has a superior filtration, and its innovative brushes are compatible on any pool surfaces which enhances its compatibility and efficiency. It is also equipped with intelligent scanning to assess and efficiently cleans the entire pool.

Other products such as robotic pool cleaner for natural pools and cordless battery powered pool cleaners are unique to Maytronics.

Smart Pool

Fluidra has recently launched Fluidra Connect which is smart control systems through which a customer can control the entire pool through a smartphone application (app). The control system is compatible with more than 100 pool products (including pool water treatment product). The APP allows for remote monitoring and control of the entire swimming pool through the APP interface. The APP can also help in seamlessly connect to a support center who can remotely troubleshoot the pool water treatment operation. Fluidra connect is revolutionizing the pool water treatment industry by optimizing the pool water treatment and providing immense value in the form of sustainability and quality service to the customer.

Fluidra has recently acquired Riiot Labs which has developed and launched Blue. Blue is a multi-sensor (4 in 1) equipment. It can sense and communicate pH, temperature, salinity and redox/ORP to a smartphone APP which helps the customer monitor the pool water quality 24/7. Blue helps in optimizing the chemical dosage and it also helps the customer by providing customized solutions if the pool water quality is not optimal. Additionally, it helps to prevent corrosion and other chemical damages due to overdosing.

Other treatment technologies like Salt chlorinator for disinfection and energy-efficient variable speed filtration pumps are increasingly being adopted by end-users.

European Market Size

France is the largest market for pool water treatment systems in Europe with a market share of almost 25% it is followed by Spain and Germany. The growth of pool water treatment among residential and commercial end users in countries like France, Spain, Czech Republic and Italy are mainly due to their strong tourism potential and tightened pool water quality regulations and standards.

Frost & Sullivan estimated that the European Swimming Pool Water Treatment market was USD 1.24 billion in 2016 and it is expected to reach USD 17 billion in 2023 at a CAGR of 5.7%.

Pool Hudson is a Senior Research Analyst at Frost & Sullivan.
Water Quality Solutions: Some Experiences from the Ground

DUNGURIPADA, A SMALL village in Saipala Gram Panchayat of Nuapada district in Odisha, had only one tube- well fitted with a handpump to get water for drinking and other domestic purposes. The community was under the impression that tubewell water is safe for consumption. In 2013, WaterAid India along with their local partners Regional Centre for Development Cooperation (RCDC) intervened in the district and conducted a ground assessment. The assessment found that the tubewell contained fluoride of 5 parts per million, which is way beyond the permissible limit.

With some guidance, the villagers learned that a sanitary well (dugwell fitted with handpump with due assessment and protection measures from the sanitary point of view to avoid physical and bacteriological contamination) can be a safe source of water. However, it was not an easy task to implement. Each household contributed manpower to dig the 18 feet deep well, break boulders and construct the wall. They also contributed INR 11,150 to meet the cost for sand, cement, transportation and the mason. Even fluorosis affected people contributed in some form or the other.

The reasons behind the popularity of the sanitary well as a safe water source were, firstly it was easy to install, operate and maintain. Additionally, it was cost-effective and could be done at the community level. Since then, a number of villages in the district have already adopted the sanitary well concept to get safe drinking water. Kadameri is another village in Nuapada that has constructed 16 sanitary wells so far. The model has been well appreciated by the Government and Rural Water Supply and Sanitation department has so far constructed 45 sanitary wells across the district to combat the issue of fluoride.

The key lessons learned from Dunguripada community is that once an ideal solution to a community’s problem has been identified, it makes sense to work on their capacity development as well as encourage them to rely on themselves to sort their own problems. The government’s approach of one-size-fits-all, where engineers in no way get involved with the community, results in a pre-mature death due to the lack of proper Operation and Maintenance (O&M) compounded with heavy recurring cost. This is exactly what has happened in the village in Gaya in Bihar that I wrote about a few months back - An expensive engineering driven solution without any thoughts on O&M.

It’s not that those options are not viable or shouldn’t be tried. But in a context where the state is often found wanting in terms of its reach and willingness to invest in those who are on the margins, it is imperative that solutions are found near to the people. And as they say, till the cows come home! However, the government does need to play a critical role in several areas. Here is a select list to ponder over from a report WaterAid published on water quality issues some years ago.

The government can take a cue from its own massive awareness drive being conducted in the Swachh Bharat Mission. If people’s lives are at stake, it certainly needs to drive a much more urgent and a massive campaign around the perils of contaminated water.

Testing and Remedial Action: There is an urgent need to enhance the monitoring network by establishing monitoring stations across all regions and seasonal assessments of all water sources. In case of contamination detected, an action plan for dealing with sources should be provided. The challenge lies in establishing well-equipped laboratories with well-trained staff.

Capacity Building of Communities: The role of panchayats is critical. Increasingly, stress is being laid on community-based approaches in dealing with water-related problems. A prerequisite for increasing the community participation is the training of people from the communities so that they are able to make well-informed decisions.

Making the Service Provider Accountable: Article 21 of the Constitution of India relates to the Protection of Life and Personal Liberty and the right to pollution-free water is guaranteed under this provision. The user has the right to know whether the water, being provided at source, is free from any contamination as claimed by the authorities. Financial expentiture on water supply schemes and testing water quality should be known to the public. A clear chain of command and accountability needs to be established in all these instances. Bihar’s recently enacted Public Grievance Redressal Act (a national version of it was drafted some years ago and lays buried now) can be a good start for any such redressal.

On the other hand, the lack of maintenance of rural water supplies and infrastructure is an area of concern. This may be due to lack of funding capacity, apathy or unwillingness on the part of the communities to handle operation and maintenance. This calls for a change in the shift among the users that the onus of maintaining a water source rests with the people and the communities as they are the owners of the system and are most likely to be impacted in case of the degradation of the water supply system. This calls for a joint implementation by panchayats and communities. With the coming of decentralized funds to villages via the 14th Finance Commission, increased funding is now available to look at these eventualities.

Also, the benefit of institutionalizing community participation is that it propels the search for alternate water sources, water harvesting options, and simple, low-cost treatment technologies. Similarly, the revival of traditional water conservation structures like tanks, lakes, ponds that have been in use in India since ages could provide another viable option. These served as sources of water for people by capturing rainfall and surface runoff. However, in the past few decades, one has seen many of these structures becoming dysfunctional.

However, awareness, surveillance, monitoring and testing, mitigation measures, and monitoring and camping at the grass root level as a mechanism to identify problems and take corrective measures. None of these solutions is novel or untested. The question is that of the political will of the people. If they can be mobilized, governments will be forced to respond.

Avinash Kumar is Director - Programme, and Policy at WaterAid India.

@Avinashkoomar
Leading Water Utilities Reducing Water-Energy Nexus Pressures

By Robert C. Brears

WATER IS REQUIRED to produce nearly all forms of energy. At the same time, electricity is needed to provide drinking water and treat wastewater. Recognizing rising water-energy nexus pressures, a range of water utilities around the world are developing innovative solutions to reduce these pressures.

Melbourne Water has hydro-electric power stations operating throughout its supply network, generating renewable energy from the flow and pressure of moving water, with the electricity being fed back into the grid.

In addition to the nine existing power stations, five additional mini-hydro plants were commissioned in 2016-2017. The plants were delivered in pre-assembled, self-contained units and provide simple, weather-resistant power delivery solutions that can be brought online quickly. In total, the 14 hydro-electric power stations can generate up to 69,500-megawatt hours of electricity per year.

By operating these power stations, Melbourne Water prevents over 75,800 tons of carbon dioxide emissions each year, which is equivalent to the emissions of over 14,000 households or taking more than 29,000 cars off the road. Meanwhile, at Melbourne Water’s Western Treatment Plant, which serves 1.6 million people in the central, northern, and western suburbs of Melbourne, sewage is considered more than a waste product, with the utility generating electricity by combusting biogas that is captured under covers that are placed over the sewage treatment lagoons.

The Western Treatment Plant uses biogas to meet nearly all its electricity needs with 71,500-megawatt hours of renewable energy generated each year, which prevents 87,000 tons of carbon dioxide being emitted through the burning of fossil fuels. At times the treatment plant generates excess renewable energy which is exported to the electricity grid to offset usage at the utility’s other sites.

Athens Water Supply and Sewerage Company (EYDAP) has launched an ambitious program of renewable energy utilization with the objective of contributing to the optimization of energy balance across the country and society and exploring the possibility of expanding to new profitable business.

Along the aqueduct system that brings raw water into the Athens area for treatment, there are existing energy-dispersion works (small waterfalls along the aqueduct). EYDAP is in process of converting these energy dissipation works into energy production plants, therefore taking advantage of the aqueducts’ hydropower potential.

These energy production plants consist of temporarily redirected water flowing through a turbine that converts the hydraulic energy potential into electricity by use of a generator. The water then rejoins the aqueduct at a lower elevation and continues its flow to the water treatment plant.

To date, EYDAP has constructed six small hydropower plants along its aqueducts located in Kifissia (700 kW), Ellinikon (650 kW), Kartaia Khalirion (1,200 kW), Mandra (630 kW), Evinos Dam (820 kW), and Kildi (590 kW).

San Antonio Water System (SAWS) is harnessing methane gas generated during the wastewater treatment process as a renewable energy source. The biogas - which is 60% methane - is a by-product of the anaerobic digestion process from biosolids, with SAWS producing around 140,000 tons of biosolids per annum. SAWS has partnered with Ameresco, Inc., a national energy company that focuses on renewable energy.

Since 2010, Ameresco has processed more than 1.5 million standard cubic feet of biogas a day and delivered a minimum of 900,000 cubic feet of natural gas each day to the nearby commercial pipeline to sell on the open market. Economically, SAWS receive around $200,000 in annual royalties from the sale of the biogas, reducing the costs of SAWS operations and keeping rates affordable, while environmentally the harnessing of biogas instead of flaring reduces 19,729 tonnes of carbon dioxide each year.

Scottish Water Horizons - a commercial subsidiary of Scottish Water - has teamed up with SHARC Energy Systems to establish a joint venture to expand and accelerate the deployment of wastewater heat recovery systems across Scotland. Scottish Water Horizons will provide commercial funding for the projects while SHARC Energy Systems will provide the design, build, and operational expertise for the green energy installations.

The Scottish Government is supporting the scheme too by providing 50% capital support through its Low Carbon Infrastructure Transition Programme.

The SHARC heat recovery technology, which took six years of research and development, extracts the natural warmth found within the wastewater network, which sits at around 21 degrees Celsius by a) Using a patented system to separate solids and liquids within the wastewater stream via a unique clog-proof mechanical filtration system, b) Directing the filtered wastewater through a heat exchanger to extract the natural heat, and c) Using a heat pump to boost the temperature even further (to around 60 degrees Celsius) before transferring the heat for heating of buildings and hot water systems during the winter season.

Economically, SAWS receive supply agreement). Commercial, private, and public customers who sign up with the innovative heat system do not pay any up-front investment costs. Instead, the customer signs up to a long-term heat supply agreement with all the design, installation, and supply of equipment costs.

In a joint project between Hamburg Wassers and Eisenbahnhauvein Harburg (EBW), around 220 housing units of a residential complex of the housing cooperative in Hastedtstrasse were retrofitted to enable heat from wastewater to warm their water and night storage heaters. In this residual heat from wastewater is captured and an exchanger transfers it to the heating center of the residential district. From there, the heat is transferred to a buffer storage ready for use by the housing units. During peak times, any additional heat required is generated from a modern gas heater. Meanwhile, in Hamburg’s Stellingen district, Hamburg Wasser makes use of the fact that its groundwater has a constant temperature of around 9 degrees Celsius throughout the year by transferring this natural cold to a cooling system that is connected to the neighboring Arctic Ocean of the Hagenbeck Zoo. This ensures that the polar bears and penguins stay cool in the summer.

Robert Brears is the author of Urban Water Security, Founder of Mitigation, and Our Future Water."
What Role Can People Play to Effectively Achieve SDG 6 and Other SDGs?

By Karen Delfau, IWC for the Australian Water Partnership (AWP)

Tony Slatyer emphasized during his Kini Interview that each and every one of us has a role to lay in achieving SDG 6 by 2030. Bringing the SDGs and SDG 6, in particular, into our everyday lives is an admirable but also achievable objective that made me pause and reflect. This column explores Tony’s ideas for how we can all contribute, as a part of our professional and personal lives, to SDG 6. It is hard to think of a resource more precious, and more important, than water.

Sustainable Development Goal 6 (SDG 6) strives to ensure availability and sustainable management of water and sanitation for all, recognizing how important this is for health, economic prosperity, and environmental sustainability.

While SDG 6 has direct links with activities professional undertake in the water sector, it is also a goal that people of all abilities, professions, and interests can contribute to.

“Whatever you do, whatever you’re doing, whatever your profession is, whatever your skill and mandate is, wherever you are in the whole landscape, you have a leadership role to play,” counsels Tony Slatyer, Special Advisor for the High-Level Panel on Water for the Australian Government.

Making SDGs Happen

Slatyer explains that leadership means inspiring and encouraging others, raising public awareness and continuing conversations about SDGs.

“Everybody from the most junior official or young scientist to the wizened gurus in the world can all exercise that leadership,” he says. “You only have to look at the basic facts, statistics around how far we have to go in the next 13 years, how much good can be achieved to start to create conversations and new thinking about that.”

While not every idea will be the best one to accomplish SDG 6 or other goals, they are all valuable as contributions and may work to spark other plans and projects that will impact the world.

“Don’t be afraid to bring forward radical new ideas that could contribute to SDGs,” says Slatyer. “Let’s let all the good ideas bloom and bring them into whatever governing body framework you work with, put up your hand, get involved. These are things everybody can do wherever they’re working and wherever they’re sitting.”

Getting Involved With SDGs

Slatyer asks “everybody who is in a position to do anything that is a step towards achieving that goal to get on with it and to talk about it and mobilize their peers and colleagues and exercise the leadership that is needed if we’re going to achieve this in the next 13 years.”

What Does This Look Like, Practically?

For stakeholders who are directly involved, it may be easier to find a role in the framework of making SDGs a reality. For those who want to help but are not already involved, the task may seem daunting, but there are several ways to help.

Consider raising awareness of SDG 6 and other goals through campaigns and information sharing, particularly in areas where people may not have heard about these efforts before. If you have expertise in water management or another applicable field, volunteer your time and your skills. Use your own behavior as a good example of sustainable water use, explaining to others why it is important to you in the context of SDGs. Help collect data, amass knowledge, and encourage participation in any activities that further the SDGs. Every role counts in making these goals a reality.

The Australian Water Partnership (AWP) is an Australian Government development initiative enhancing the sustainable management of water across the Indo-Pacific.

@WaterPartnersAU

Attaining SDG 6 is key to reducing conflict. Water resources are finite. These finite resources face pressure and competition that is only increasing, both locally and globally.
Strategic Partnership Announced Between Thermosift and Memsift Innovations to Establish Business in South-East Asia

The partnership will allow the companies to conduct a joint pilot project in Singapore. This joint pilot project will start in August 2018.

and membranes are based on patented award-winning technologies that provide unique benefits over traditional brine treatment and zero liquid discharge solutions. Thermosift’s TS-30™ system uses an innovative Joule Thomson Effect (JTE) based thermal separation process and a proprietary membrane STOMATE™ that brings down the water treatment costs significantly. Similarly, Memsift Innovations is developing and licensing innovative membrane technologies to provide solutions for the South East Asian market. Memsift’s membranes could compliment the TS-30 system, by expanding its application in various industry sectors. The partnership also includes a close commercial collaboration between the companies, optimizing commercial synergies and making use of the complementary geographical presence and client bases in South East Asia region. In addition, the partnership will allow the companies to conduct a joint pilot project in Singapore. The joint pilot project will start in August 2018.

Dr. J Antony Prince, the Founder of Memsift Innovations said, ‘Through this strategic partnership we will be able to reach our clients with a larger and even better product offering. It really combines the best of both worlds and it will help our clients with better brine treatment and zero liquid discharge solution. We are very excited about the opportunity to work with Thermosift and the important commercial opportunities it presents to our companies’.

EXPRESS WATER Exclusive

Mayur Sharma talked to Dr. J Antony Prince (Founder, Memsift Innovations) about this new announcement.

What was the basis of this partnership (technology and market wise) and how did it materialize?

Dr. Prince: The basis of this partnership is to combine the effort to commercialize the technology in a wider market. Both parties are focusing on the zero liquid discharge mark where Thermosift has a unique product TS-30™ (a novel membrane-based ZLD system) and Memsift found there is a huge market opportunity for this technology in the SEA region. Hence, Memsift decided to work with Thermosift to expand the market for the TS-30 system.

Tell us more about your marketing and growth plans in South East Asia.

Dr. Prince: In the coming year, Memsift’s primary focus will be on bringing this technology to the market. As an initial step, Memsift will identify potential end users to pilot this technology in the real field condition and we are committed to start the first commercial pilot in Singapore by August 2018. Memsift will also look for strategic partners to bring this technology in the SEA market.

Which industries can specifically get benefit from TS-30 system, STOMATE membranes, and Memsift’s membranes, and why?

Dr. Prince: Mining, galvanizing, electroplating, and semiconductor industries are using an excess of inorganic acids and the wastewater containing these inorganic acids are categorized as hazardous waste and there are regulations to transport and incinerate these wastes. If we use this novel decentralized membrane based ZLD system, it can recover the acid from the waste, which can be potentially used in the process again. The dissolved metals will be concentrated and recovered from the wastewater, which can also be used in the process; this will help the industry to be more sustainable.

Give us some more background of your planned joint pilot project with Memsift in Singapore.

Dr. Prince: As per our current plan, Memsift will identify the potential end user to pilot the technology in one of the above industries in Singapore. Thermosift will provide the technical expertise to develop the pilot system in Singapore. The feed flow to the system will be at least 2500 L/day. In this pilot, we are expecting to recover diluted acid and concentrate the metal salt from the industrial effluent. If this project is successful, it will be an ideal example for the circular economy.
The event highlighted the benefits of internationally approved standards and codes.

The Workshop on Water and Sanitation Systems in India provided an opportunity to share experiences and best practices from a U.S. company and standards developers and foreign counterparts. Presentations by U.S. and Indian experts from both the private and public sectors focused on water quality, and wastewater management. U.S. private-sector speakers included individuals from the American Society of Mechanical Engineers (ASME), the American Water Works Association (AWWA), Headworks International, the International Association of Plumbing and Mechanical Officials (IAPMO), and NSF International. Additionally, representatives from USTDA and the U.S. Commercial Service gave opening remarks and were in attendance. The Indian water sector was represented by the following private and public organizations: BIS, the Ministry of Commerce and Industry, the Indian Plumbing Association (IPA), the Safe Water Network, the Defence Research and Development Organisation (DRDO), the Indian Plumbing Skills Council (IPSC), the Indian Water Works Association (IWWA), the Delhi Jal Board, the Water Quality Indian Association, and the Ministry of Drinking Water and Sanitation.

According to IAPMO’s senior vice president of government relations, Dain Hansen, high-quality product standards are a “vehicle to drive industry and foreign investment. IAPMO stands eager, ready, and willing to work together with Indian stakeholders to update construction codes, adopt internationally recognized product standards, and not only create an environment for companies to invest, but also increase the overall health and safety of the country’s water and sanitation at the same time.” Further, this workshop successfully brought together many of the sector’s vital Indian stakeholders into the same room to reflect on the successes and challenges for their water sector; enhance their exposure to international water standards and codes, and facilitate conversation on actions needed to be taken.

Sponsored by the USTDA and coordinated by ANSI and CII, the program aims to facilitate India’s development of transparent and streamlined standards, conformity assessment, and a technical regulations system. SCCP also aims to provide information on U.S. and Indian standards and conformity and U.S. technical assistance to facilitate increased U.S.-India trade and investment; encourage greater Indian public and private sector participation in international and regional standards and conformity assessment fora; and support increased cooperative exchange between U.S. and Indian counterpart organizations working to address trade-related issues at the technical level.
DUDEK, A LEADING multi-disciplinary environmental and engineering consulting firm, has announced the certification of the Pure Water San Diego Environmental Impact Report and Environmental Impact Statement (EIR/EIS). The milestone marks the completion of a three-year analysis of the proposed Pure Water Program by Dudek. One of the most ambitious water recycling programs in the nation, the Pure Water facility seeks to treat 83 million gallons per day to produce potable water for San Diego’s more than three million residents.

Currently, the County of San Diego imports 85 percent of its water supply from the Colorado River and Northern California Bay Delta. As imported water costs continue to rise, the County is increasingly vulnerable to water shortages and drought. The Pure Water Program aims to provide one-third of San Diego’s water supply by 2035 by increasing local control of a sustainable water supply and alleviating dependence on imported water. The Pure Water Program also boasts notable environmental benefits, including the protection of local waterways and the preservation of natural habitats.

The Miramar Reservoir

The Plant Schematic

**The Project**

As one of the most ambitious water recycling programs in the nation, the City of San Diego’s Pure Water Program seeks to treat 83 million gallons per day to produce high-quality drinking water through the design and construction of newly advanced water purification, pumping, and conveyance facilities, as well as upgrades to existing facilities.

- City of San Diego, Public Utilities Department, San Diego, California
- EIR certified in 2016
- 83 million gallons per day
- One-third of San Diego’s water supply by 2035

**Projects Tracker**

**City of San Diego Pure Water Program**

Dudek announces approval of Pure Water San Diego environmental impact report/environmental impact statement.
Mayur Sharma discussed the project and its significance with its project manager - Shawn Shamlou, AICP. He is a principal with 20 years' experience preparing environmental documentation for land-use planning and infrastructure projects for public and private clients. He has prepared more than 200 reports complying with the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA) and has served as project manager and primary author of many environmental review documents throughout San Diego County and California. Mr. Shamlou has overseen and managed a broad range of environmental documents for healthcare, transportation, aviation, rail, port, water, and energy infrastructure projects.

Q. The San Diego Pure Water project is one of the most ambitious water recycling programs in the USA. What is the plan to produce high-quality drinking water on a large scale? Which technologies will be used?

Shawn: The North City Project is Phase I of the Pure Water Program. This phase includes several projects that will clean recycled water to produce 30 million gallons per day (MGD) of high-quality purified water starting in 2021, reducing the City's dependence on imported water. Approximately 32 MGD of wastewater will be transported to the North City Water Reclamation Plant, where it will be treated before being sent to the new North City Pure Water Facility located across the street for further purification. Using the proven five-step water purification process of ozonation, biological advantages for the region, including a reduction in the flow of treated wastewater effluent to the Pacific Ocean.

Dudek analyzed potential environmental impacts associated with construction and operation of the Pure Water San Diego facility, as well as long-term effects associated with changes in water supply procurement. The expertise of the Dudek team ensured the City of San Diego Development Services Department received the nearly 3,000-page Final EIR/EIS on schedule. The San Diego City Council unanimously certified the documentation in April. Dudek is now supporting the City with obtaining key permits from the Army Corps of Engineers, California Department of Fish and Wildlife, and Regional Water Quality Control Board.

“Dudek is absolutely thrilled to have the opportunity to work on the Pure Water San Diego project which sets a new nationwide precedent for water recycling on such a grand scale,” said Project Manager Shawn Shamlou.

“Our team was fortunate to work directly with the City of San Diego and Bureau of Reclamation agencies. Their professionalism and technical expertise inspired the Dudek team to work even harder to meet their schedule targets and successfully deliver a comprehensive environmental document that will serve as a benchmark for similar projects.”

Q. What is the significance of this project for the region, looking at the water shortages and rising costs of water import?

Shawn: San Diego relies on importing 85% of its water supply from the Colorado River and Northern California Bay Delta. The cost of this imported water has tripled in the last 15 years and continues to rise. With limited local control over its water supply, the City of San Diego is more vulnerable to droughts, climate change, and natural disasters. Pure Water San Diego is a phased, multi-year program that will provide 1/3 of San Diego’s water supply locally by 2035.

Q. How green and sustainable is this project?

Shawn: The project will be a tremendous net benefit and alternative to the environmental costs of importing potable water from distant sources, including a substantial reduction in energy and use of greenhouse gases resulting from the distant transport of water from the Colorado River and Bay Delta.

Also, a new North City Renewable Energy Facility is proposed to be located at the North City Water Reclamation Plant. Landfill gas from the City's Miramar Landfill gas collection system will be supplied to the facility via a new 12-inch diameter Landfill Gas Pipeline. The new facility will produce a total of 15.4 MW of new generation capacity and will incorporate 5 MW of existing power generation capacity already at North City Water Reclamation Plant. The power supplied by the North City Renewable Energy Facility will be used for additional energy needs at the expanded North City Water Reclamation Plant as well as for the new Pure Water Facility and pump stations (with the exception of the Morena Pump station). Backup power would be provided by SDG&E only to maintain minimal critical operations if the main power supply failed.

Q. Can you summarize the overall environmental impact assessment of this project for us? And what were the practical challenges in preparing this report?

Shawn: A joint Environmental Impact Report/Environmental Impact Statement (EIR/EIS) was prepared in compliance with the California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA). The EIR/EIS evaluated three alternatives: the No Project/No Action Alternative, the Miramar Reservoir Alternative, and the San Vicente Reservoir Alternative. The City approved the Miramar Reservoir Alternative.

CEQA requires a determination of the significance of impact on the environment.

Environmental issue areas including land use, aesthetics, air quality, biological resources, environmental justice, geology and soils, greenhouse gas emissions, health and safety, historical resources, hydrology and water quality, paleontological resources, recreation, public services, public utilities, and water supply were found to be less than significant with or without the need for mitigation measures. The project would, however, result in significant and unavoidable impacts to noise and transportation.

Preparation of the document required coordination between the City of San Diego and the US Bureau of Reclamation in order to meet each agency’s needs for the environmental assessment. The North City Project would require a variety of discretionary actions, approvals, and permits by the City, US Bureau of Reclamation, and various agencies.

The document must provide sufficient analysis and conclusions to meet the needs of the various agencies that have approval responsibilities for items such as permits and easement requirements. The already complex nature of the environmental analysis was further compounded by an aggressive schedule and required coordination amongst agencies.
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The second edition of AWWAIndia’s annual conference aims at “Uniting the world of Indian Water Industry”. AICE’18 will connect policy makers, utilities, industries, OEMs and academicians to find innovative solutions for challenges facing India’s water industry. Don’t miss your chance to soak up the knowledge, network, interact and learn from local and global industry veterans who will share a case study just for you.

**AICE’17 Snapshots**

1. **1st ever Water/wastewater Utilities Council Meet**
2. **200+ Delegates**
3. **1st ever Women Council Meet**
4. **7 Technical Sessions**

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XII World Aqua Congress
International Conference & Exhibition
22nd - 23rd November, 2018, New Delhi, India

Theme: Enhancing Water Use Efficiency

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15 minutes special commercial / promotional slot is available to the industry to make presentations on their latest techniques, solutions, new discoveries, latest innovations, major breakthrough, etc. This is the opportunity to present your technology to policy makers, decision makers, stakeholders, consultants and end users.

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Aqua Foundation's Excellence Awards

The “Aqua Foundation’s Excellence Awards” are the highest awards given by Aqua Foundation to its members, stakeholders and contributors in recognition of their outstanding achievements in the field of water, environment, energy, earth sciences, atmospheric sciences, planetary sciences, pollution control and sustainability solutions. Aqua Foundation honours, in each World Aqua Congress, individuals & organizations who have made a mark in their respective fields of expertise or have made a significant contribution in the field of water, environment and humanity.

Number of Awards: The number of awards shall be between 0 and 40.

*The last date for submitting Award application is 30th September, 2018

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- Water Efficiency in Construction Sector
- Water Resources: Availability, Management, Quality
- Financial, Institutional, Legal & Policy Issues

Submission Timeline: 20th August, 2018

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