



energy recovery™

DESALINATION

PRODUCTS CATALOG

Table of Contents

Overview of Energy Recovery Products for Desalination.....	3
PX Pressure Exchanger Technology.....	4
Prime Performance Energy Services Agreement (ESA).....	5
PX Prime.....	5
Available PX Solutions.....	6
Choose The Right PX Solution for Your Plant.....	6
Energy Recovery Turbochargers.....	7
AT Turbocharger (Advanced Turbo).....	8
LPT Turbocharger (Low-Pressure Turbo).....	9
Pumps.....	10
AquaBold High-Pressure Pump.....	11
AquaSpiré High-Pressure Pump.....	12
High-Flow Vertical PX Circulation Pumps.....	13
Low-Flow Circulation Pumps.....	13
Energy Recovery Retrofit Solutions.....	14
Case Studies.....	15
Global Installations, Massive Energy Savings.....	17
Aftermarket Service and Support.....	18
About Energy Recovery.....	19

Overview of Energy Recovery Products for Desalination

PX® Pressure Exchanger®, Turbocharger and Pumps

Energy Recovery has spent decades perfecting devices that capture and recycle otherwise wasted pressure energy, making desalination a more economical and viable option for regions with a growing demand for fresh water. Our flagship PX Pressure Exchanger technology is the most widely used and efficient energy recovery technology in desalination where an energy recovery device is viable. In addition, our high quality hydraulic turbocharger energy recovery devices offer substantial savings to mitigate upfront capital costs. Combined with our family of pumps, these devices offer plants of all sizes and in any location a variety of energy recovery solutions to meet their specific plant needs.

For more than 20 years we've worked to provide state-of-the-art technology to the desalination industry. We've invested years in research and development as well as millions of dollars to build the most efficient energy recovery devices available today. From corrosion-resistant steel to highly engineered ceramics, our technologies represent innovations in both material science and fluid dynamics.

Our competitive edge allows us to develop technologies designed for dependability and maximized uptime. With nimble operations and some of the finest engineers in the business, we house research, development and manufacturing under the same roof, allowing us to develop the most advanced devices with speed and precision. We put all our devices through rigorous testing, so they can withstand the harshest conditions and operate at peak efficiency, even after years of service.



PX Pressure Exchanger Technology

The Most Widely Used Energy Recovery Device in the World

Energy Recovery's award-winning PX Pressure Exchanger family of products is unmatched in the industry in terms of usage and efficiency. More than 18,000 energy recovery devices are currently in use around the globe, and in the majority of seawater desalination projects where energy recovery technology is viable. Here's why.

Up to 98% Energy Savings

The PX captures hydraulic energy from the high-pressure reject stream of the seawater reverse osmosis process and transfers this energy to the low-pressure feed water stream with a peak efficiency of up to 98%. Because the PX itself consumes no electrical power, overall energy consumption is drastically reduced.

Landmark Engineering and Material Science

The PX device is made of aluminum oxide, a highly engineered ceramic that's three times as abrasion-resistant as steel. The durability of this material allows the PX to perform without interruption in the harshest conditions.*

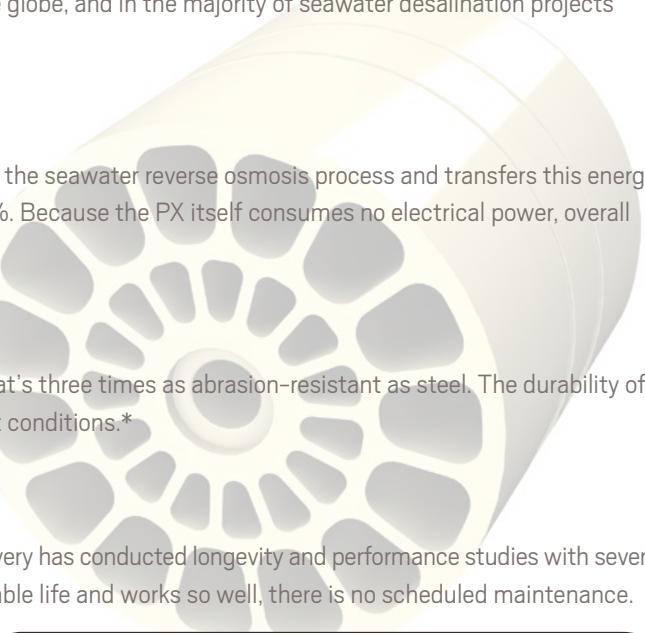
Highest Availability, Longest Life

With only one moving part, the PX is designed to resist failure. Energy Recovery has conducted longevity and performance studies with several devices used for years in the field. The PX is designed for 25+ years of usable life and works so well, there is no scheduled maintenance.

Reduced Pumping Requirements

The PX requires a much smaller high-pressure pump than what has historically been used in desalination. The technology also physically separates the high-pressure pump from the energy recovery device. These two factors combine to give plants much more flexibility in operations and can allow plants to reduce their power consumption by as much as 60%.

VASILIKOS PLANT



PX Pressure Exchanger at a Glance

- Up to 98% energy savings
- No scheduled maintenance
- Virtually zero downtime
- Designed for a 25-year life
- Self-regulating speed adjustment with flow
- No pulsation, valves, pistons or timers
- No need for complicated data communication systems
- Industry standard FRP housing
- Alumina rotor 3x more abrasion resistant than steel
- Titanium, super duplex and super austenitic stainless steel wetted metal components
- Quick and smooth start-up

*When used as directed.

Prime Performance Energy Services Agreement (ESA)

Energy Recovery's Performance Promise at Zero Upfront Cost*

Energy Recovery's Prime Performance ESA is the only product on the market that allows customers to upgrade their RO high-pressure pumping and energy recovery systems virtually risk free and with no upfront capital*, promising actual efficiency savings in one all-inclusive solution.

What do you get with the Prime Performance ESA?

- PX Pressure Exchanger – designed to be the most efficient, durable and reliable energy recovery device on the market
- A comprehensive “turn-key” solution, customized to maximize plant savings – can include pumps, piping, ancillary equipment (flowmeters, valves, etc.)
- Energy Recovery’s performance promise – customers pay for the solution with a portion of the actual efficiency savings generated by the Prime Performance ESA
- Includes all routine maintenance and installation costs* – parts and labor
- A true partner – Energy Recovery will be with you for the life of the energy service agreement term

Savings can include:

- Reduced energy consumption
- Elimination of routine maintenance and repair costs
- Productivity improvements
- Increased plant utilization (availability)
- And more...

What are the advantages of Prime Performance ESA?

- ESA payments treated as an operating expense – no balance sheet impact
- Zero upfront capital cost* so customers can invest capital in their core business
- Equipment routine maintenance and upgrades included
- Access to the next generation of PX technology

*Customer responsible for site preparation for efficiency solution

PX Prime™

The Industry's Best Energy Recovery Solution

The PX Prime is the latest advancement in Energy Recovery's award-winning PX Pressure Exchanger line, and it is the most advanced energy recovery device for desalination available on the market. We have engineered the PX Prime to perform with even less fluid mixing and enhancements across a variety of factors. The performance has become so dependable, we can offer the PX Prime through the Prime Performance ESA, passing significant capital expenditure savings on to our customers and ensuring they pay for the solution with a portion of actual savings.



PX Prime at a Glance

- First PX available with no upfront costs*
- Less fluid mixing
- Industry leading efficiency
- Greater capacity

Available PX Solutions

Due to the modular design of the PX Pressure Exchanger, our technology can be installed into small, medium and large plants, including pilot plants, brackish water, and mobile marine units. PX units are typically used in parallel to service larger systems and incorporate design improvements that increase capacity and improve durability.

Choose The Right PX Solution for Your Plant

PX Q Series

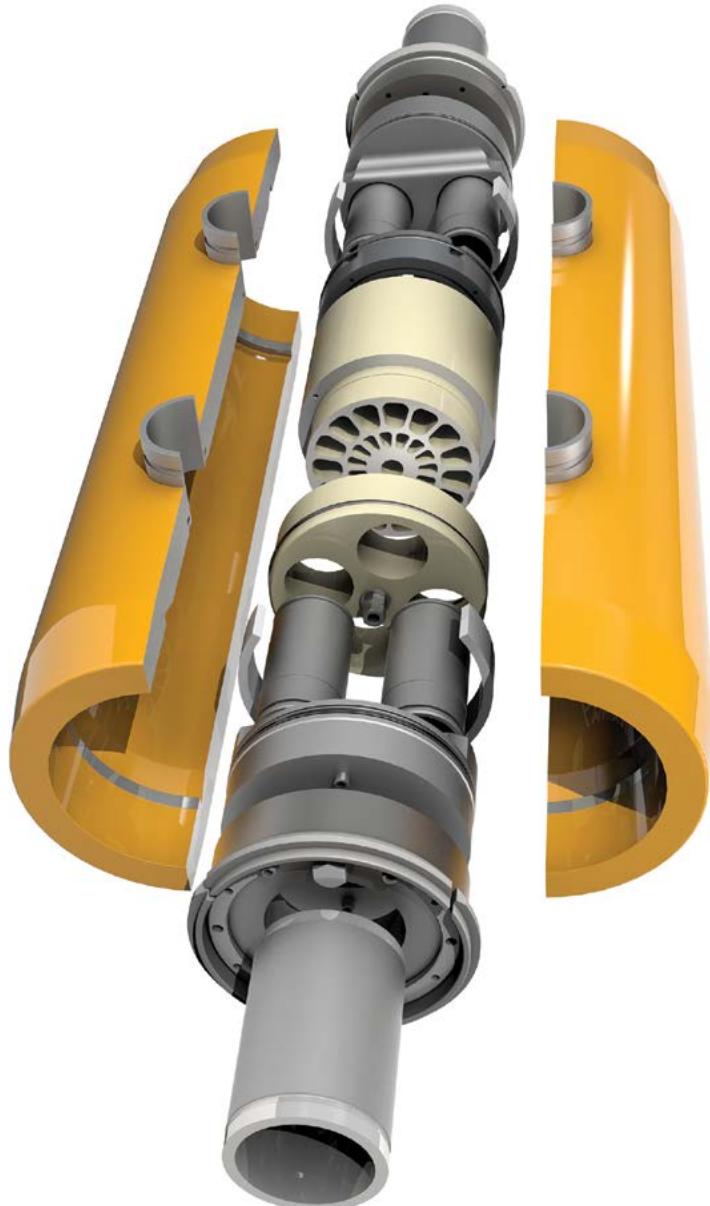
Part of Energy Recovery's Q series, the PX Q300 is the best energy recovery device available for capital purchase. With the same compact footprint as the PX Prime and a robust capacity of 300 gpm, the PX-Q300 is designed for any size reverse osmosis desalination plant, with an energy efficiency up to 98%. The PX Q series offers noise reductions as low as 80 decibels. The PX Q series is also available in other models including the PX Q260.

PX Pressure Exchanger Performance Chart

Figures are calculated using a "mid-flow" range. Use the Energy Recovery Power Model Tool on our company website to help you create a new plant design or a retrofit of an existing plant.

PX Model	Minimum Guaranteed Efficiency*	Flow Range per Unit (brine flow)
PX-Q300	97.2%	45.4 - 68.1 m ³ /h
PX-Q260	96.8%	40.8 - 59 m ³ /h
PX-260	96.8%	40.8 - 59 m ³ /h
PX-220	96.8% (@45.4 m ³ /h)	31.7 - 49.9 m ³ /h
PX-180	96.7% (@36.3 m ³ /h)	22.7 - 40.8 m ³ /h
PX-140	94.8% (@22.7 m ³ /h)	20.4 - 31.7 m ³ /h
PX-90	96.0% (@15.8 m ³ /h)	13.6 - 20.4 m ³ /h
PX-70	95.3% (@11.3 m ³ /h)	9.08 - 15.8 m ³ /h
PX-45	94.0% (@7.9 m ³ /h)	6.81 - 10.2 m ³ /h
PX-30	93.4% (@5.6 m ³ /h)	4.54 - 6.81 m ³ /h

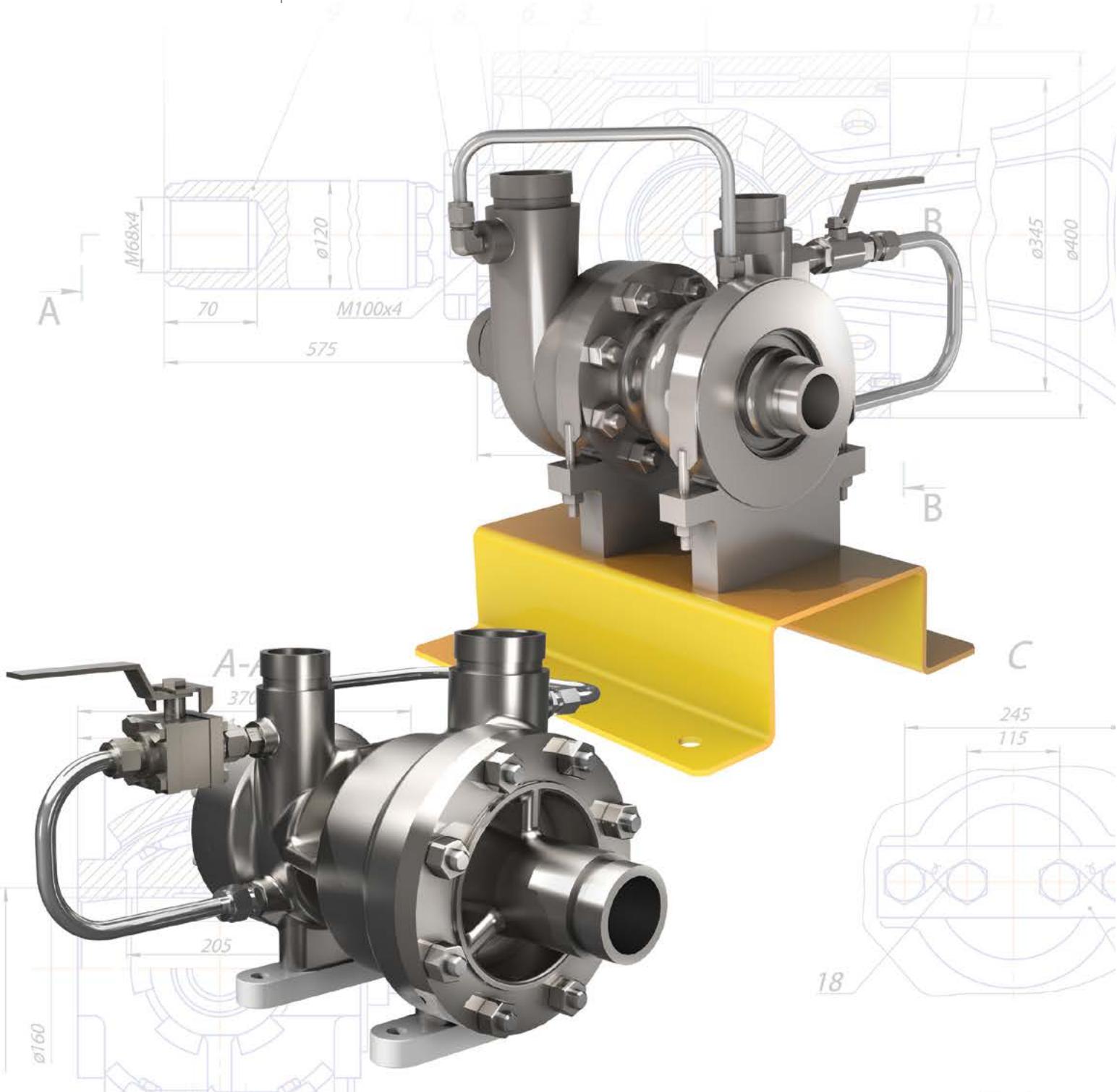
*These minimum guaranteed efficiencies are based on Energy Recovery's factory performance test standards. Models include Q300, Q260, 260 and 220



Energy Recovery Turbochargers

More Economical Options for Energy Recovery Technology

Our high efficiency Turbochargers are suitable for both high-pressure seawater and low-pressure brackish reverse osmosis systems. They offer high-performing energy recovery solutions in projects with smaller budgets—especially in locations where power costs are heavily subsidized or there's a need to mitigate upfront capital spending. Easy to maintain, our Turbochargers are supported by highly qualified and seasoned technical field services professionals around the clock.



AT Turbocharger (Advanced Turbo)

High-Performance, Low-Cost

Our AT Turbocharger (Advanced Turbo) is a flexible solution that simplifies the RO desalination system while maintaining its operational reliability. Easy to install, with a compact footprint, the AT Turbocharger requires minimal installation time, operator training and plant design. The device requires no instrumentation or ancillary equipment.

Ideal for any size seawater reverse osmosis system, the AT Turbocharger handles flows from 50 to 10,000+ gallons per minute (11 to 2,272 m³/hr) and pressures from 600 to 1,200 psi (45 to 80 bar). For a centrifugal solution, the innovative volute insert technology allows systems to perform at a best efficiency range rather than a single best efficiency point. This offers plants increased flexibility should operating conditions change, and maintains existing, maximum efficiency.



AT Turbocharger at a Glance

- More than 80% energy efficiency
- Reduces energy consumption
- Increased efficiency with 3D geometry impellers
- Volute insert technology for best efficiency range
- Low installation cost
- Process lubricated bearings
- Compact footprint
- Duplex (2205) and Super Duplex (2507) Stainless Steel
- Investment casting up to model AT-1500

Models

AT-95	AT-1500
AT-250	AT-2150
AT-350	AT-3250
AT-425	AT-4150
AT-550	AT-6000
AT-875	AT-7800
AT-1100	AT-11000

LPT Turbocharger (Low-Pressure Turbo)

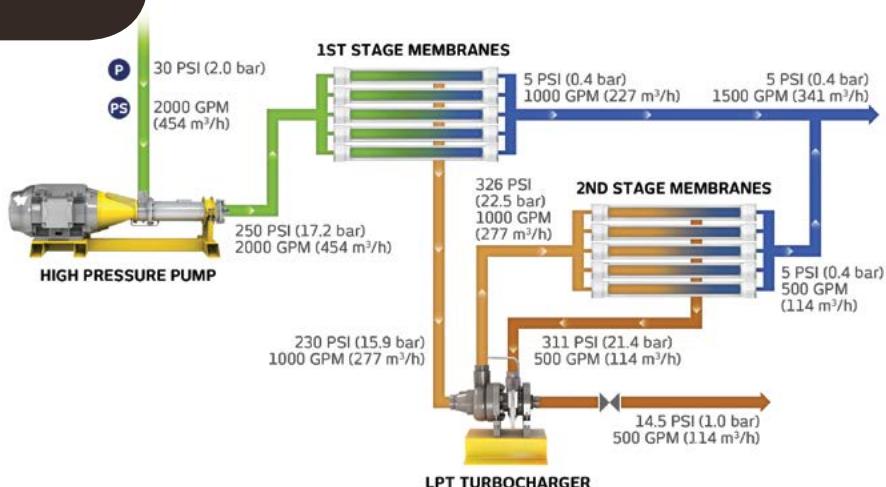
High-Performance for Low-Pressure Systems

The LPT Turbocharger is a high-performance, low-cost energy recovery solution for low-pressure RO desalination systems that reduces the required pressure provided by the high-pressure pumps, thereby minimizing energy consumption. This device offers many benefits, including a compact footprint and long-term reliability and durability. The LPT Turbocharger gives operators the advantages of low-pressure, inter-stage pressure boosting to balance flux between stages, multi-stage reverse osmosis systems, and energy recovery—all at an affordable price.

Ideal for low-pressure applications such as multi-stage brackish reverse osmosis water treatment, this device handles flows from 30 to 4,000 gallons per minute (6.8 to 908 m³/hr) and pressures up to 650 psi (45 bar).

LPT Turbocharger at a Glance

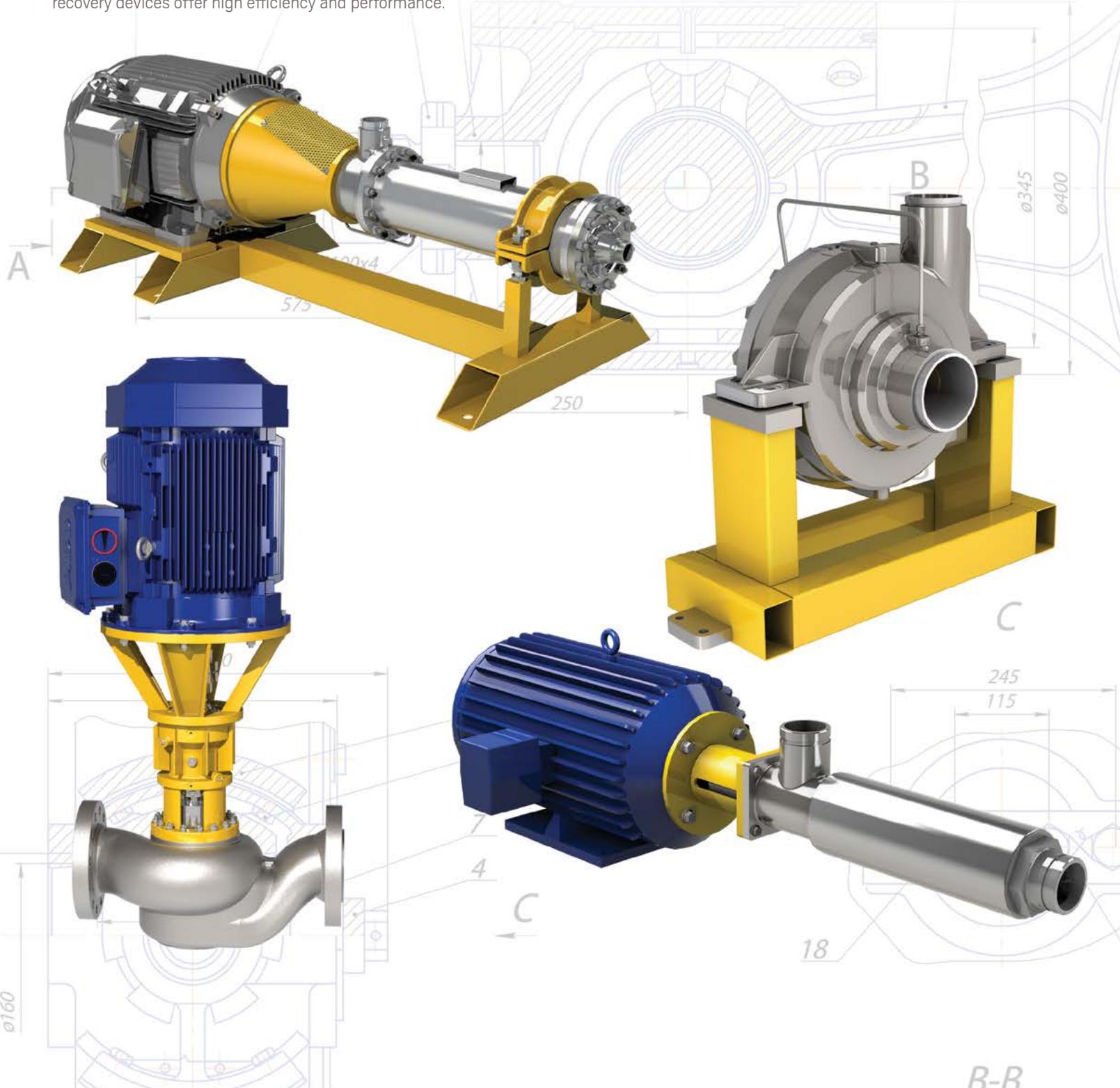
- Increased efficiency with 3D geometry impellers
- Energy recovery/inter-stage booster pump in one device
- 20–30% lower energy consumption
- Heavy duty cast and machined stainless steel impellers
- No energy costs for inter-stage pumping
- Process lubricated bearings
- No electrical feed or controls
- No shaft seals
- Compact footprint



Pumps

High-Pressure Multi- and Single-Stage Centrifugal Pumps

We've invested years of research and development to build highly efficient energy recovery devices, bringing you versatile solutions that will meet the demands of any size water project or environment. When combined with our family of pumps, our isobaric and centrifugal energy recovery devices offer high efficiency and performance.



AquaBold™ High-Pressure Pump

The AquaBold pump is our flagship multi-stage centrifugal pump, ideal for large-scale reverse osmosis systems. Designed to perform with maximum power savings, it handles flows from 100 to 1,300 gallons per minute (23 to 300 m³/hr) and pressures up to 1,200 psi (83 bar).

With a flexible operating range in both flow and pressure, the AquaBold is designed to work in combination with either PX or turbocharger systems.



"By taking its technology globally, desalination plants in areas of high water scarcity such as Algeria and other parts of northern Africa as well as financially constrained communities in India and China are realizing the effects of Energy Recovery's efforts. Energy Recovery is enabling these countries to achieve their strategic initiatives to water security, accessibility and sustainability."

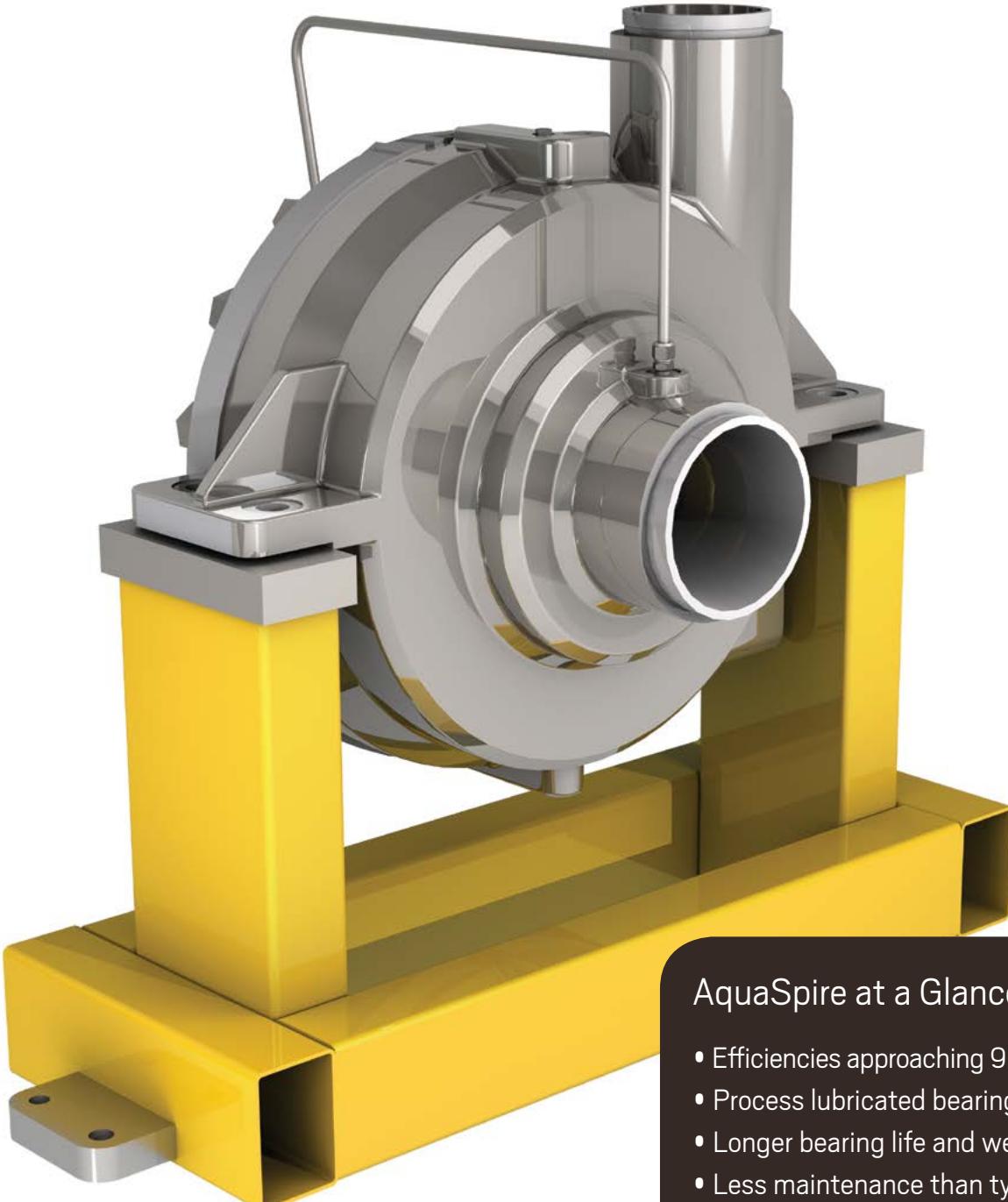
Nikolay Voutchkov
President
Water Globe Consulting

AquaBold at a Glance

- Efficiencies exceeding 80%
- Process lubricated bearings
- Longer bearing life and wear cycle
- Less maintenance than typical pumps
- Low life-cycle cost
- Heavy duty cast and machined stainless steel impellers

AquaSpire™ High-Pressure Pump

The AquaSpire is a single-stage, high-pressure pump, ideal for medium- to large-scale seawater and brackish water reverse osmosis systems. It handles flows from 250 to 12,000 gallons per minute (57 to 2,725 m³/hr) and pressures up to 650 psi (45 bar). It is designed to complement our AT Turbocharger.



AquaSpire at a Glance

- Efficiencies approaching 90%
- Process lubricated bearings
- Longer bearing life and wear cycle
- Less maintenance than typical pumps
- Low life-cycle cost

High-Flow Vertical PX Circulation Pumps

VPXP™ Series

Designed to be used in combination with our PX devices in seawater and brackish reverse osmosis plants, with the purpose of compensating hydraulic losses in the PX circulation loop, these circulation pumps have flow rates ranging from 640 to 12,000 m³/day.

High-Flow Vertical Circulation Pumps at a Glance

- Compact vertical inline design
- Highest efficiencies
- Long life and low maintenances
- Low energy consumption
- Reliable performance in high operating pressures
- Specifically designed for SWRO/BWRO applications
- ASME 600# flanges for easy installation
- 50/60 Hz TEFC motor, ready for VFD control



Low-Flow Circulation Pumps

HP Series

Designed to be used in conjunction with our PX devices, Energy Recovery circulation pumps are intended for seawater reverse osmosis plants with permeate production rates ranging from approximately 25 to 250 gpm (135 to 1,350 m³/day).

Low-Flow Horizontal Circulation Pumps at a Glance

- Longer bearing life and wear cycle
- Enhanced corrosion resistance
- Less maintenance
- Specifically designed for SWRO/BWRO applications

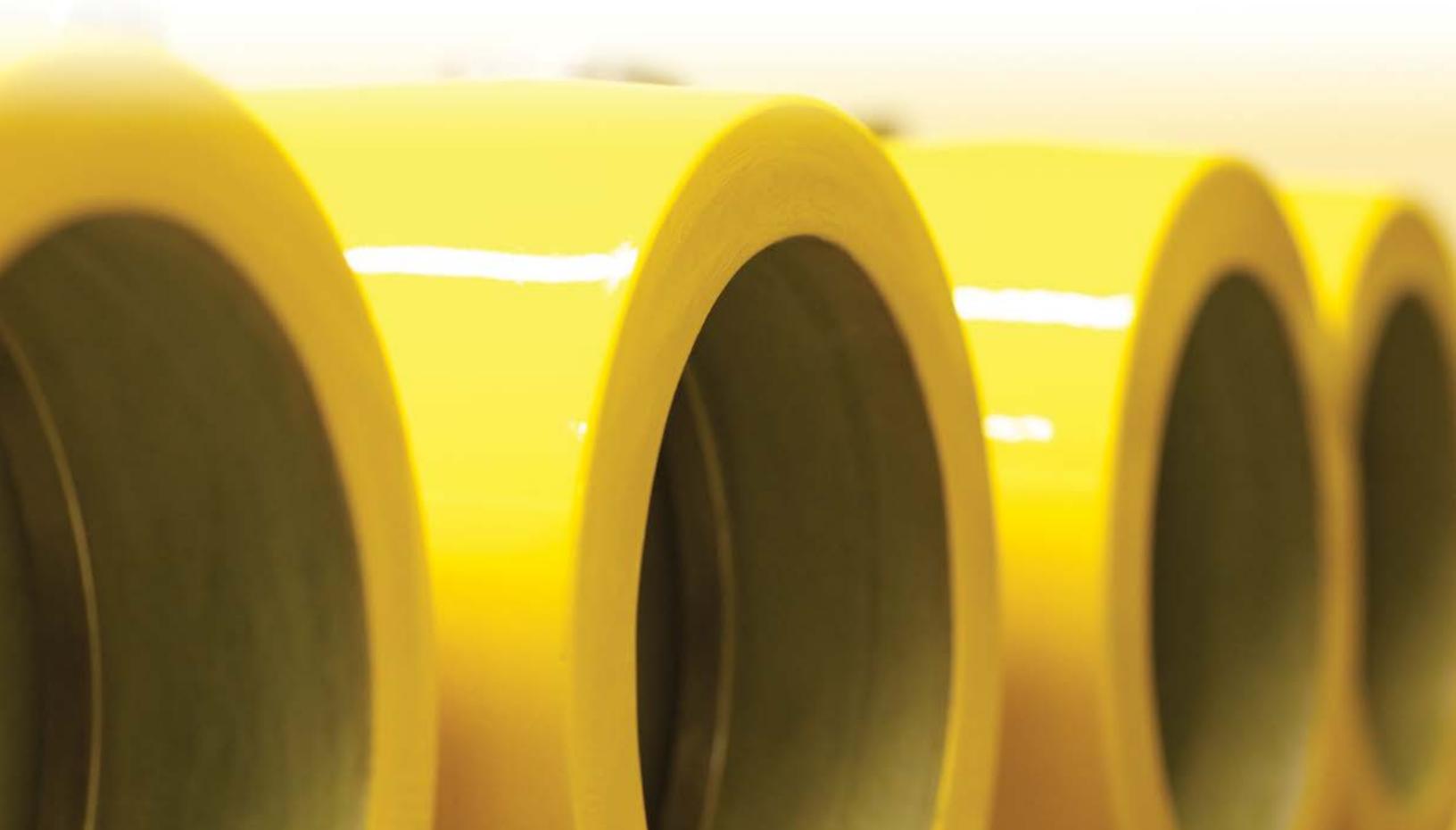
Energy Recovery Retrofit Solutions

Many SWRO plant owners choose to retrofit with Energy Recovery's PX devices to improve plant performance and increase energy savings. Retrofitting existing SWRO plants with our energy recovery devices can reduce the power consumption of existing systems by as much as 60%. Alternatively, the existing system's capacity can be increased with little or no additional power requirements and with minimal additional equipment. For example, PX devices and a circulation pump can be installed in any orientation between membrane racks or even in a piping trench.

A retrofit can nearly double the capacity of an existing SWRO train. In a typical retrofit, the legacy ERDs are removed, the original high-pressure pump remains, and PX devices and circulation pump(s) are added. Generally, the retrofitted system has twice the number of membranes and nearly double the permeate flow for the same size high-pressure pump. There are countless configurations to fit your needs.

"Thanks to Energy Recovery's PX Pressure Exchangers, [our] plants consume less than 40% of the specific energy of traditional marine reverse osmosis plants, and have saved the company up to US \$500,000 over four years in energy costs."

David Murdoch, Managing Director
H2AU
Australia



Carlsbad Desalination Plant, California, USA

Helping Launch the Largest Seawater Desalination Plant in the Western Hemisphere

As drought conditions have persisted in California, desalination has become a more attractive option to provide additional fresh water. Furthermore, California reservoir levels have reached historic lows. The state needed to create new sources of fresh water to supply the growing population and increasing industrial demand. The Carlsbad SWRO desalination plant in southern California is the largest plant of its kind in the western hemisphere. To make desalination a more environmentally and economically viable option, Energy Recovery supplies the PX Pressure Exchanger, an energy recovery device that recovers pressure energy and reduces the energy requirements of the desalination process.

The new Carlsbad Desalination Plant has a capacity of 50 MGD (million gallons per day, or 189,270 m³/day); it is ideally located with proximity to the ocean and co-located with the Encina Power Station. The project will produce up to 10 percent of the fresh water supply for San Diego County. California's first large-scale plant went online in the third quarter of 2015 and will save an estimated 116 million kWh (kilowatt-hours) of energy per year using the PX, the equivalent of \$12 million annually. This energy savings will also reduce CO₂ emissions by 41,000 metric tons per year—roughly the annual greenhouse gas emissions from 8,632 passenger vehicles or 44 million pounds of coal burned.



Udupi Thermal Power Plant, India

Making an Energy-Efficient Steam System Power Plant in India

The Udupi 1300 MW Thermal Power Plant, located in Udupi, near Mangalore, Karnataka, India, is a coal and gas power generating station with a plant capacity of 16,200 m³/day. It converts water into steam, which is then used to drive turbines, producing power. Vast amounts of water are needed to generate steam, and since only pure water can be used, seawater reverse osmosis desalination is the most viable option to produce the water.

Partnering with Triveni Engineering, the plant is configured with four Centrifugal High Durability AquaSpire 2400 pumps and three AT Turbocharger 2400 energy recovery devices. A total of three trains have been running since May 2010. Using our technologies, the plant worked at full capacity within one year.

Llobregat Desalination Plant, Barcelona, Spain

Solving a Drought Crisis Through Desalination

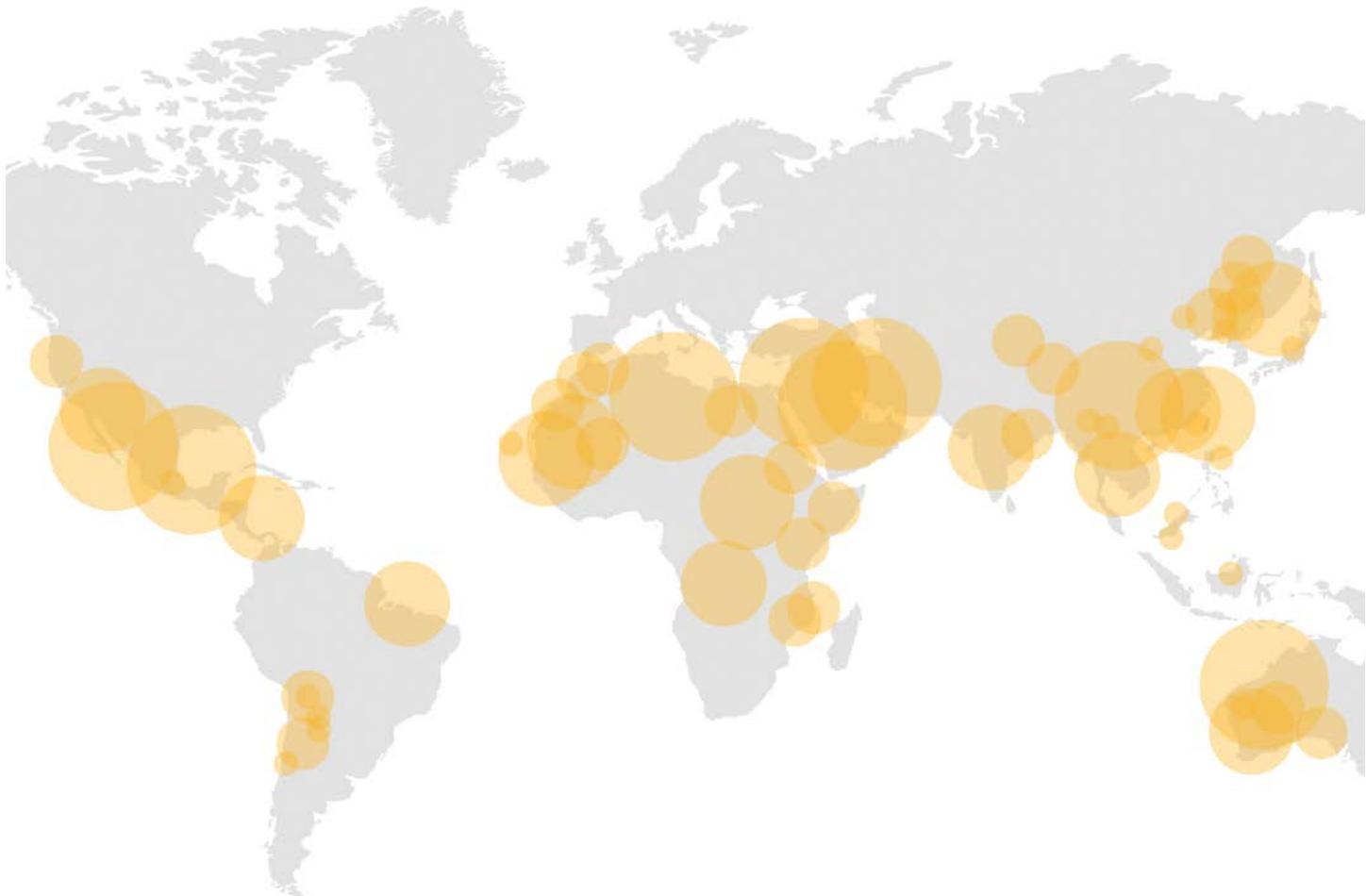


Barcelona endured lengthy spells of severe drought, creating serious water shortages. In 2008, the city imported fresh water at substantial cost. To ensure a secure and reliable water supply, the government explored many possible solutions and decided that reverse osmosis desalination was the most viable long-term option. With a capacity of 200,000 m³/day (52.8 million gallons/day), the Barcelona (Llobregat) Desalination Plant is one of the largest seawater reverse osmosis (SWRO) desalination plants in Europe. Built on behalf of Aigües Ter Llobregat by a consortium of Aigües de Barcelona (AGBAR), Dragados, DRACE medioambiente and Degrémont, the plant will deliver water to an estimated 4.5 million residents in the region, accounting for about 24 percent of the area's water supply.

The plant is located on the left bank of the Llobregat Delta, alongside the Baix Llobregat Wastewater Treatment Plant. It is configured into two production lines, each with a capacity of 100,000 m³/day and consisting of two passes: 10 first-pass trains with a nominal capacity of 23,100 m³/day and a partial second pass of two trains, each with a nominal production of approximately 16,500 m³/day. Each of the 10 trains is fitted with 23 PX devices and a variety of other pressure equipment. The PX devices are estimated to reduce the plant power consumption by 18 MW, saving more than 157 GWh of energy per year, and help it avoid 92,900 tons of CO₂ emissions per year.

Global Installations, Massive Energy Savings

With more than 18,000 devices installed worldwide, Energy Recovery sets the standard for innovative technology in desalination, saving clients more than \$1.8 billion (USD) in energy costs per year.



Aftermarket Service and Support

When You Invest in Energy Recovery Technology, You Don't Just Get a Product, You Get Partners

Every day we support our clients around the globe in making energy recovery economically profitable and environmentally sustainable. With more than 120 years of combined industry experience, our service and support team has the most advanced technical expertise in energy recovery systems. Wherever you are in the world, whatever size your project, we will be there to support you every step of the way. From grassroots planning, to system design and implementation, through ongoing maintenance, we are always available for you.

Installation and Service Support

Our Aftermarket Service and Support Team will supervise installation and system commissioning upon request. We've got experts strategically located in most regions of the world, including the Middle East, Europe, Asia, India, Australia and the Americas, to provide responsive, local assistance and support in a variety of languages. Once your project is up and running, we will go above and beyond to meet any maintenance requirements.

Spares and Repairs

Looking for a spare part or can't figure out what's wrong? Our team maintains an inventory of complete PX devices, pumps, parts, kits and tools at our headquarters in California. Shipments can be expedited to any part of the world*.



*Excludes countries and territories that are subject to embargo or other US trade sanctions.

About Energy Recovery

A History of Leading in Desalination

Fresh water is a finite and vulnerable resource, essential to sustaining life, economic development and the environment. Population growth and changes in climate have created an increasing demand for fresh water around the world—water for consumption, water for irrigation in food production, and water for industrial processes are all needed more than ever. Yet, other than seasonal variations, fresh water supplies are mostly fixed and can't meet the growing need.

Desalination of ocean and brackish water is a forward-looking solution to global climate change and clean water shortages. As energy recovery innovators, we've worked hard to pioneer technologies that make desalination both economically viable and environmentally sustainable without jeopardizing plant productivity. For more than a quarter of a century, our systems have revolutionized the water industry and have become the preferred technology for desalination projects around the world.

Every day, our technologies produce more than 15 billion liters, or 4 billion gallons, of clean water. In the process, massive amounts of fluid and pressure are recycled into reusable energy that would otherwise be wasted—at the highest guaranteed efficiencies and availability possible. We have more than 18,000 energy recovery devices operating globally, which save our clients more than \$1.8 billion a year.

At Energy Recovery, we focus on creating best-in-class energy recovery devices and high-pressure pumps that make processes more productive, more profitable and environmentally cleaner for our customers. Moreover, we are committed to continuous innovation, always planning for the future of our products and our business. We consider not only the initial efficiency of the equipment but also its long-term performance and reliability. We guarantee that when you partner with us, you will save energy and stay ahead of the technology curve.

Environmental responsibility and increased profits can—and should—go hand in hand. We don't have to compromise. Energy Recovery innovations are good for the planet and our competitive position in the global economy.





Energy Recovery, Inc. (ERII) is an energy solutions provider to industrial fluid flow markets worldwide. Energy Recovery solutions recycle and convert wasted pressure energy into a usable asset and preserve pumps that are subject to hostile processing environments. With award-winning technology, Energy Recovery simplifies complex industrial systems while improving productivity, profitability, and efficiency within the oil & gas, chemical processing, and water industries. Energy Recovery products save clients more than \$1.8 billion (USD) annually. Headquartered in the Bay Area, Energy Recovery has offices in Houston, Ireland, Shanghai, and Dubai. For more information about the Company, please visit www.energyrecovery.com.

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