



aerospace  
climate control  
electromechanical  
filtration  
fluid & gas handling  
hydraulics  
pneumatics  
process control  
sealing & shielding



## RENEWABLE ENERGY

Energizing innovation in wind, solar, water,  
and biogas – worldwide



ENGINEERING YOUR SUCCESS.



*“Treat the earth well:  
We do not inherit it from our ancestors,  
we borrow it from our children.”* -Unknown

## YOUR CHALLENGES:

Cost, Efficiency, Availability, Utilization, Downtime.

## OUR SOLUTIONS:

Available. Reliable. Consistent. Efficient. Robust.

Pressured to meet the demands of a world expected to consume 45% more energy by 2030, energy companies are looking for new ways of thinking as they face the challenges of manufacturing and utilizing renewable energy in a post-carbon world.

A collaborative partner and technology expert with years of experience in the field, Parker's commitment to solving the high-tech manufacturing challenges of renewable energy is unequalled.

From capture and conversion, to commercialization, integration, storage, transportation and protection, we're leading the way with engineered solutions that are both proven and practical as the world turns to alternatives in the face of high oil prices, growing concerns over energy security, and the threat of climate change.

### Happening now:

According to two recent reports on renewable energy trends<sup>1</sup> in 2011, the industry is on the grow, despite a shaky world economy.

- *Global renewable energy investment was at a record \$257 billion. Parker's investment in renewable energy research and development (R&D) has also grown every year.*
- *Solar generation surged past wind power to become the renewable energy technology of choice for global investors. Parker offers solutions for solar panel manufacturing, motion and control technologies such as pitch actuators, as well as energy extraction, power conversion and cooling, and energy storage.*
- *In 2011, renewable energy technologies continued to expand into new markets: around 50 countries installed wind power capacity. From blade pitch systems, shaft and yaw brake systems, filtration and connectors, to advanced cooling and power conversion systems, Parker solutions in wind deliver reliable performance and unsurpassed quality.*
- *Hydroelectric power continues to grow globally, with some projections estimating that global hydropower production could double between now and 2050. Parker's global hydraulic, connector, and filtration capabilities will provide significant growth opportunities.*
- *Alternative energy technologies continue to be developed. Parker is working with customers to develop offshore wave power systems using a combination of our variable-speed drive and hydraulic technologies.*
- *Although Europe dominates biogas production, the trend is also catching up fast in countries like Japan, Australia, New Zealand, and the U.S. With decades of experience in gas treatment installations, Parker continues to develop hydraulic, pneumatic, and electromechanical systems that deliver optimal results for biogas plant developers. Our significant portfolio of products and systems for biogas production increases methane content and improves the quality of fuel produced, maximizing revenue for plant owners.*



<sup>1</sup> Renewable energy trend reports issued in June of 2012 by the United Nations Environment Programme (UNEP) and the Renewable Energy Policy Network for the 21st Century \*REN21



# WHY PARKER

## FOR RENEWABLE ENERGY

### Reduced Time to Market • Global Support

From concept through production, our ability to design, prototype, and manufacture worldwide will shorten your design cycle, improve production efficiency, and simplify procurement procedures.

- Parker engineers and scientists provide valuable, early-on collaboration for production optimized design and streamlined development.
- In-house tooling and manufacturing capabilities facilitate rapid prototyping.
- Advanced manufacturing quality systems are utilized to ensure products meet leading quality standards.

These capabilities guarantee you the greatest reliability and the most competitive total cost of ownership for your renewable energy systems.

### Global expertise

Renewable energy is a key market-focused business unit for Parker. As such, Parker continues to invest heavily into the sector. With a dedicated global team of renewable experts drawn from multiple Parker divisions, the business unit leverages the power of Parker, offering cross-technology innovations and cross-market competencies to help drive down the cost of construction, maintenance, and operation while increasing engineered system innovation.



*At Parker, we don't just engineer sustainability, we live it. We work to reduce the carbon footprint of our facilities, localizing our supply chains to minimize environmental impact and reduce waste while maximizing the economic potential of the region.*

### A multiple technology provider

Proven solutions in advanced motion and climate control, filtration and condition monitoring, hydraulic and pneumatic management, actuation, instrumentation, motors and drive technology, and sealing and shielding give you a wealth of integrated, multi-technology systems, subsystems, and components engineered to work together, producing a far more efficient and reliable energy generation system.

*A condition monitoring early warning system that incorporates an icountPDR – a robust Particle Detector. Parker EWS is designed to independently monitor system contamination trends and ultimately help protect hydraulic systems.*



### Selectable levels of integration • Fewer suppliers

When it comes to suppliers in renewable energy, you want fewer companies with more capability. Our selectable levels of integration – which include components, sub-assemblies, and integrated systems – give you plenty of options, saving you time and money by reducing the need for multiple suppliers, lowering development cost and speeding time to market.



### Global and local

Your language, your time zone, your currency. No matter where you develop, assemble, manufacture or install, Parker is there. By working with us, you have access to an integrated network of global manufacturing plants, distributors, sales and service offices in every major country.

### Service and support

Our approach to customer service and support is as innovative as our renewable technologies, making your workday more productive as we reduce your hidden costs and improve your profitability with the following:

- **13,000 distributors, sales offices, and maintenance, repair and overhaul (MRO) outlets** – Instant access to parts, products, maintenance, service, and solutions.
- **ParkerStores** – Your local source for hose assemblies, hydraulics, pneumatics, filtration, and more – around the corner and around the world.
- **ParkerStore On-site Containers** – A transportable workshop providing on-site maintenance and product support.
- **HOSE DOCTOR®** – Emergency mobile hose repair and replacement in the field.
- **Kitting** – Multiple components in a customized kit with a single part number for easier order processing and assembly.
- **Piping Solution Center** – Global service centers offering single-source, non-welded piping solutions including consultation, design, assemblies, and installation.
- **Training** – Customized training sessions with qualified instructors.
- **Renewable Center of Excellence** – A global resource organizing and communicating best-in-class engineering practices for all renewable markets.
- **Parker Tracking System (PTS)** – Bar code identification labeling system helps you identify and order replacement custom hose assemblies faster.

PED

UL

ISO

DNV

DIN

### National and international certifications

National and international certifications verify that our systems and solutions offer the highest possible quality for the most efficient performance in even the most challenging environments.

ASME

CCC

CE

GL

TUV



**Parker Store**



## Harnessing the wind: Onshore and offshore

Parker has been on the forefront of wind power for over two decades, with solutions that touch virtually every critical function in the turbine. From integrated lube oil filtration systems and sealing technologies that make drive trains more reliable and bearings operate like new ... to compact blade pitch actuation systems that maximize rotor efficiency and minimize vibrations in the turbine ... Parker has the solutions that make today's advanced and sophisticated wind power plants better and smarter. Case in point? Our high efficiency power conversion systems that deliver optimum power to the grid. While our scalable evaporative cooling system lowers overall system cost with up to 40% higher power throughput.

### Two-phase evaporative cooling

Ideal for modern multi-megawatt wind turbines that utilize complex power electronics for grid frequency and power factor control, Parker's two-phase evaporative cooling takes the performance of the power modules to a whole new level. With a rack-integrated design, the cooling system offers a multitude of benefits over traditional air or water-based cooling systems deployed today. These include:

- Increased power output of up to 40% from the same system with conventional cooling
- Virtually maintenance free – no filter, water, valves, bulb replacement
- Hermetically sealed and non-conductive – safer for electrical systems and service technicians
- Up to 50% more energy efficient
- Flexibility to mount in the nacelle or at tower base (inside or outside)

**INNOVATION  
IN ACTION**



### ENGINEERING YOUR SUCCESS.

#### Driving power conversion

The Energy Grid Tie Division at Parker designs and manufactures state-of-the-art power converters and inverters for the renewable energy industry. These systems are critical to delivering clean, high quality, and compliant electrical energy to the transmission grid from variable power sources such as wind turbines, solar photovoltaic (PV) and solar concentrated photovoltaic (CPV) installations, as well as from storage reserves such as battery energy storage systems. Parker's power conversion systems also play a critical role in grid stabilization as a higher percentage of renewable energy sources are integrated into the grid and demand loads vary constantly. In addition, these systems can provide kilovolt-ampere reactive (kVAR) compensation for optimization of power factor.



# Power Source: WIND

Integrated solutions that improve wind turbine reliability and performance

## Look to Parker for:

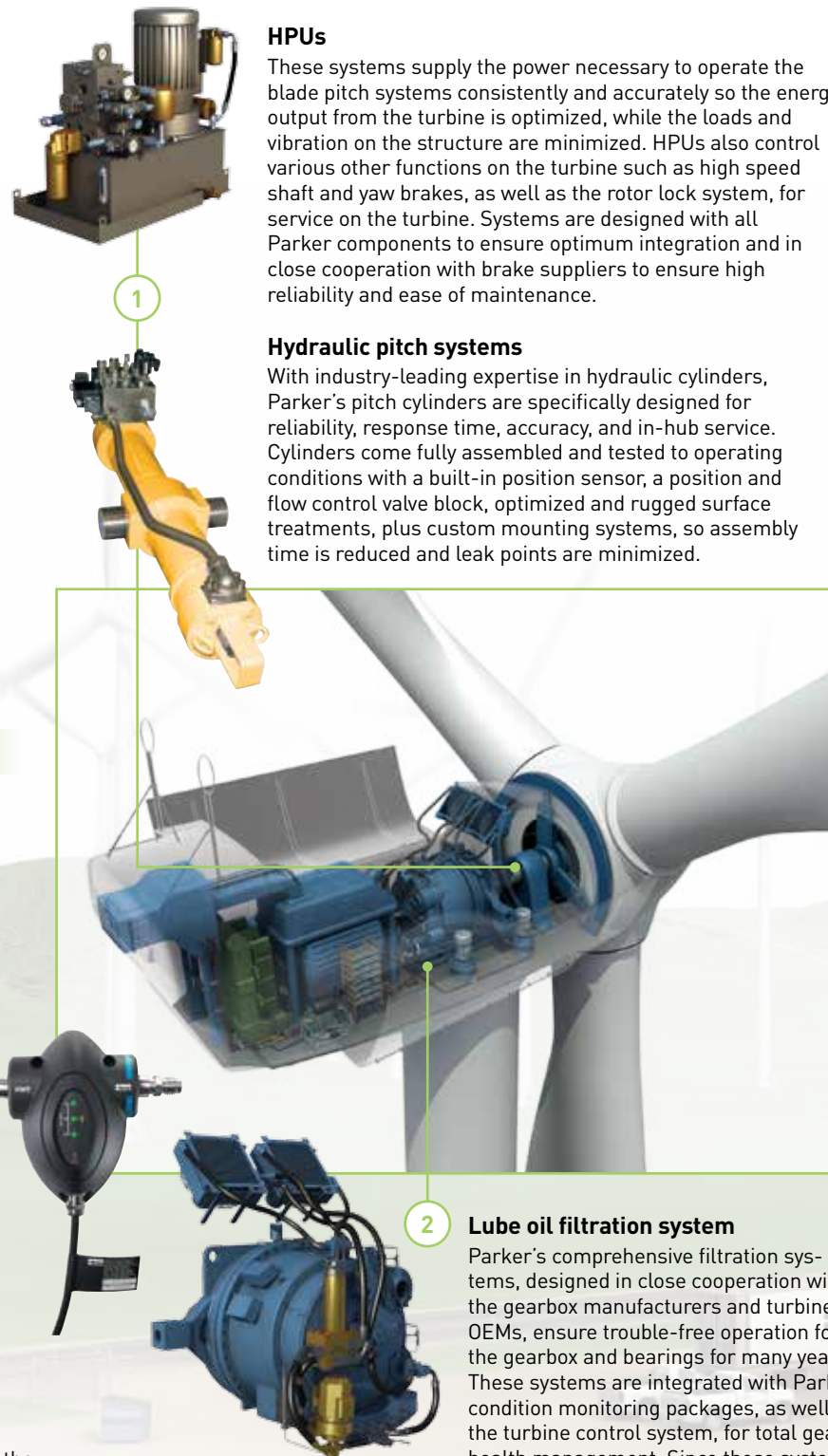
- 1 **Hydraulic solutions: pitch systems, hydraulic power unit (HPU)**
- 2 **Filtration solutions: lube oil filtration system, condition monitoring system, heat exchangers**
- 3 **Thermal management solutions: two-phase evaporative cooling**
- 4 **Sealing and shielding solutions: pitch bearing seals, labyrinth seals, rotary seals, electromagnetic interference (EMI) shielding and coatings**
- 5 **Fluid connector solutions: tube fittings, hydraulic hose and fittings, steel and stainless steel quick couplings, non-welded tube connections**

## FUNCTIONAL APPLICATION AREAS

Parker has product and system solutions for wind turbine applications that impact the following functional application areas:

- Gearbox and generator
- Blade and rotor
- Nacelle auxiliary systems

- 2 **Condition monitoring system**  
A combination of fluid, vibration, and acoustic sensors, in working with a data acquisition system and the turbine control system, ensure reliability and uptime on the wind turbine and prevent expensive unplanned downtime. Parker's sensors operate in real time on mechanical and electrical components of the drive train and analyze fluids on the turbine to accurately assess the health of the turbine and prevent/predict failures rather than confirming them.
- 2 **Heat exchangers**  
Parker has the industry's broadest range of heat exchangers for the wind energy market. Based on the fluid medium and cooling requirements, along with space constraints and form factors, Parker designs and manufactures heat exchangers that have industry-leading cooling efficiency.



### HPUs

These systems supply the power necessary to operate the blade pitch systems consistently and accurately so the energy output from the turbine is optimized, while the loads and vibration on the structure are minimized. HPUs also control various other functions on the turbine such as high speed shaft and yaw brakes, as well as the rotor lock system, for service on the turbine. Systems are designed with all Parker components to ensure optimum integration and in close cooperation with brake suppliers to ensure high reliability and ease of maintenance.

### Hydraulic pitch systems

With industry-leading expertise in hydraulic cylinders, Parker's pitch cylinders are specifically designed for reliability, response time, accuracy, and in-hub service. Cylinders come fully assembled and tested to operating conditions with a built-in position sensor, a position and flow control valve block, optimized and rugged surface treatments, plus custom mounting systems, so assembly time is reduced and leak points are minimized.

### Lube oil filtration system

Parker's comprehensive filtration systems, designed in close cooperation with the gearbox manufacturers and turbine OEMs, ensure trouble-free operation for the gearbox and bearings for many years. These systems are integrated with Parker's condition monitoring packages, as well as the turbine control system, for total gearbox health management. Since these systems are optimized for turbines, careful consideration is given to ease and frequency of service of filter elements to minimize operating costs.

### Pitch bearing seals

With expertise in material science and profile design, Parker supplies pitch and yaw bearing seals that are optimized for weather, abrasion, and duty cycle and yet have low friction resistance compared to those of other suppliers. Parker also has the ability to provide rapid prototyping and test custom designs.

### Labyrinth seals

Non-contact labyrinth seal technology gives Parker ProTech™ bearing isolators unmatched, two-way sealing for zero lubricant leakage and total exclusion of contaminants. Superior to isolator seals that rely on internal o-rings.

### Rotary seals

High performance materials and patented designs deliver reliable, long seal life for a vast range of profiles ranging in size from 1/2" to 80" in diameter (12 mm to 2,032 mm). Split seal profiles available for easy installation.

### EMI shielding and coatings

Parker's EMI shielding products can be found in many OEMs' and their suppliers' electrical and electronic systems deployed in wind turbines. Optically enhanced display screens, EMI shielding low-profile and closure-force materials and tapes, optical filters, conductive elastomers, and fabric over foam gaskets all form an integral part of control cabinets. Conductive coatings and adhesives play a key role in ground fault and lightning protection of key components and structural elements.

### Hydraulic hose and fittings

Parker has the most comprehensive range of hoses and fittings for all fluid handling applications in wind turbines – hydraulic fluid, lube oil, water/glycol and generator/inverter coolant. Designs exceed performance and reliability standards and help minimize operating costs.

- 5 **F37 Non-welded tube**  
New Parflange® F37 system eliminates welded tube connections and the associated headaches with assembly, cleaning, and repairs. The system comes in a broad range of tube sizes and materials and is rated up to 6,000 psi (420 bar) operating pressure. Ideal for use on offshore wind turbines.

### Two-phase evaporative cooling

Can cool power conversion equipment as well as other systems including the reactor, transformer, and generator. Enables up to twice the power density or up to 40% higher throughput from existing electronics at a lower system cost.

# WIND ENGINEERED SOLUTIONS



**>> SensoControl®**

**Situation:** Remote locations and a challenging service environment make it difficult for wind technicians to diagnose the turbine's primary hydraulic and lube systems using minimum equipment to transport up to the nacelle.

**Solution:** A set of standardized diagnostic tools and sensors make SensoControl® ideal for use on wind turbines. Sensors measure pressures, temperatures, oil levels, and cleanliness using existing sampling ports on the equipment.

**Customer Advantage:** Packaged for modularity and portability, the SensoControl system can be easily carried to the nacelle and the measured data recorded, printed, or communicated in real time for analysis. A must for every service technician's toolbox.



**>> ParFit™**

**Situation:** Frequent replacement of low dirt-holding capacity and inefficient hydraulic filter elements requires frequent and expensive service intervals.

**Solution:** Parker's ParFit™ hydraulic and lube oil filter elements are designed to upgrade any filtration system with Parker's industry-leading media that is optimized for long life in wind turbines of all sizes.

**Customer Advantage:** The industry's leading dirt-holding capacity, lowest pressure drops, and high beta ratings of ParFit elements ensure a clean lube oil supply to the gearbox while minimizing replacement intervals. A wide range of elements allows for the consolidation of purchases and better inventory management.



**>> Hydraulic accumulators**

**Situation:** With extreme duty cycles and a critical safety function to fulfill, accumulators continue to be a high service and maintenance component in wind turbines.

**Solution:** Designed specifically for wind turbines, Parker has the industry's broadest range of accumulators in various materials and functional styles to meet operating and environmental conditions on all types of turbines, and in any climate.

**Customer Advantage:** Parker accumulators are designed and tested specific to turbine conditions and location, ensuring optimum performance and reliability. Features such as real-time position feedback and the industry's longest recharge cycle ensure lowest maintenance costs.



**>> ECO SE air cleaner**

**Situation:** Harmful dust can ingress inside the turbine's electrical and control cabinets via the air inlet passage, resulting in catastrophic damage to components and potentially, the turbine.

**Solution:** The Parker ECO air cleaner, when fitted onto the air inlet of the electrical cabinet, electrostatically traps harmful dust particles and allows only clean, dry air into the cabinet.

**Customer Advantage:** The air filter reduces repair costs from unplanned maintenance due to dust damage. In addition, a custom safety gasket protects the user during element changes. Collected dust and debris stay safely contained inside the disposable housing, eliminating the chance of contaminating the system during air filter service.



**>> Labyrinth seals**

**Situation:** Seals on the high speed bearings in the gearbox can allow brake dust to enter the gearbox while also leaking lube oil outside, causing expensive repairs and unsafe conditions for technicians. Tighter seals create severe drag.

**Solution:** Parker's labyrinth seals with state-of-the-art materials and profile design keep the dust out and the lube oil inside the gearbox, while minimizing drag.

**Customer Advantage:** Gearbox and bearings keep operating like new, repairs and cleanups are minimized, oil change-outs and disposal are reduced, and clean, safe working conditions are maintained in the nacelle. Buckets to collect oil outside the gearbox are eliminated.



**>> Fluid connectors**

**Situation:** Fluid system leaks in a wind turbine can be expensive to manage and repair. They can cause irreparable damage to the hydraulic, gearbox, and electrical systems, creating a dangerous situation for turbine technicians, as well as environmental damage.

**Solution:** Parker has the industry's largest selection of wind industry approved and tested hoses, fittings, and couplings. Manufactured by Parker globally, every product ensures full compatibility across the range. With standard sizes up to 152 mm (6 inches) and pressure ratings of up to 4,000 bar (52 kpsi), Parker has the fluid connector solution for every system on a wind turbine.

**Customer Advantage:** Globally standardized solutions, global availability, and leak-free connections ensure lowest assembly, maintenance, and repair costs and a safe working environment.





## Advanced systems for photovoltaic (PV) and concentrated solar power (CSP) methodologies

Solar power is the most plentiful source of energy on the planet. Light from the sun can be directly converted to electricity via PV cells or by using mirrors or lenses to concentrate sunlight to a central receiver (CSP). Parker provides advanced systems that can be used in both methods of solar power. Our solutions include megawatt scale solar inverters and hydraulic motion systems for both PV and CSP, as well as engineered sealing solutions, thermal management solutions, and the most complete line of fluid connectors in the world. In addition, we offer established manufacturing and supply chain expertise to support large projects like solar fields. If you are designing or planning to build a solar field, Parker can provide customized solutions that will help you optimize your return on investment.

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### EHA superior for pitch control

Parker has developed a robust, self-contained electrohydraulic actuator (EHA) system that provides utility scale PV developers with an ideal solution for adding PV pitch control into large solar field installations. The compact EHA system is a completely self-contained unit combining a double-acting actuator, pump, and electric motor that eliminates nearly all leak paths into or out of the package. It offers clear advantages over comparable electromechanical actuator (EMA) systems because all the internal wear items are permanently lubricated for extended life and the power density of an EHA is typically three times that of a comparable EMA. Designing an EHA into a pitch system allows designers to move more PV panels with fewer actuators and controls, resulting in lower installation costs and longer service over the life of the solar field.



### Outdoor-rated, utility scale solar power inverters are best-in-class

Long a trusted supplier of advanced electrical power conversion systems and a pioneer in utility scale energy storage systems, Parker has developed an advanced, megawatt-class PV solar inverter utilizing the company's cutting-edge precision cooling system (PCS) technology. The marriage of advanced cooling and sophisticated electronic design results in best-in-class efficiency, a smaller physical envelope than that of our competitors, and a completely sealed system ideal for desert environments. Parker solar inverters also incorporate maximum power-point tracking (MPPT) and fault handling capabilities to maximize availability and minimize service interruptions.

INNOVATION  
IN ACTION



# Power Source: SOLAR

Robust solutions that result in maximum power generation utilization

Look to Parker for:

## Concentrated Solar Power (CSP) Solutions

- 1 Hydraulic rotary tracker for CSP
- 2 Engineered HPU's and hydraulic cylinders for CSP tracking systems
- 3 Portable hydraulic oil purification system

## Photovoltaic (PV) Solutions

- 4 Thermal management for PV electronics
- 5 Electrohydraulic linear positioner for PV pitch control
- 6 Utility scale central inverter for PV



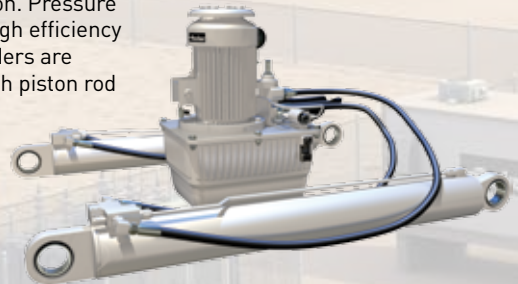
**Hydraulic rotary tracker for CSP**  
A turnkey solution that eliminates the need for on-site assembly of the drive pylon. Ships directly to the construction site and can be installed in less than one hour. Our direct drive tracker is factory built and 100% tested, ensuring an efficient build out of the solar field.

## CSP SOLUTIONS



### 2 Engineered HPU's and hydraulic cylinders for CSP tracking systems

Specially designed HPU's for CSP are engineered to resist water and sand ingress. Pressure balanced gear pumps combine high efficiency with dirt tolerance. Custom cylinders are designed for CSP applications with piston rod treatments rated for up to 500 hours of salt spray protection and paint systems developed for high ultraviolet (UV) exposure. Integrated hydraulic counterbalance valves and spherical bearings are also standard.

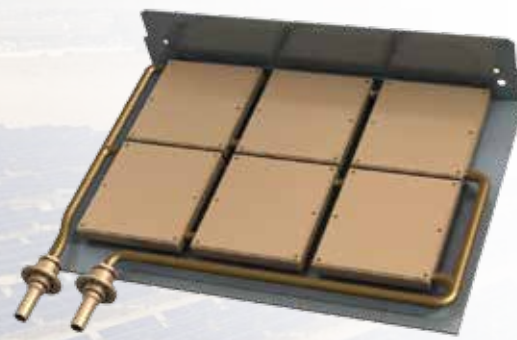


### 3 Portable hydraulic oil purification system

Hydraulic systems operating outdoors often suffer from premature failures due to dirt and water contamination. Our portable fluid conditioning systems can be deployed in remote locations. Oil reconditioning can be scheduled and the oil from multiple units can be collected and cleaned at the same time. Portable fluid conditioning units can also remove water from hydraulic fluid, which is especially damaging.



## PV SOLUTIONS

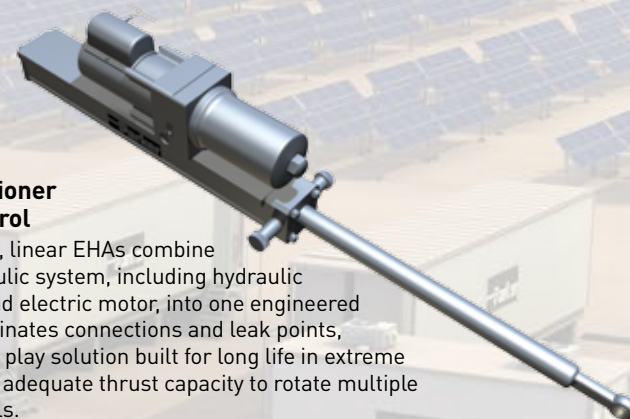


### 4 Thermal management for PV electronics

Advanced two-phase PCS can be integrated into power electronics to provide the highest density of heat removal capability currently available. Closed-loop system does not rely on water so there is no danger of corrosion or contamination of the coolant.

### 5 EHA linear positioner for PV pitch control

Our self-contained, linear EHAs combine a traditional hydraulic system, including hydraulic pump, reservoir and electric motor, into one engineered package. This eliminates connections and leak points, offering a plug and play solution built for long life in extreme environments with adequate thrust capacity to rotate multiple rows of solar panels.



### 6 Utility scale central inverter for PV

Parker's unique, two-phase refrigerant cooling system results in a megawatt class central inverter in a compact outdoor duty enclosure. The high efficiency design integrates proven insulated gate bipolar transistor power conversion and magnetics with Parker's groundbreaking cooling technology. No air conditioner is required; power semiconductors, inductor, and internal ambient are all cooled by the integral two-phase system. Multiple access panels make installation and scheduled maintenance quick and easy.



# ENGINEERED SOLUTIONS



### >> icount bottle sampler for cleanliness monitoring

**Situation:**  
Thousands of liters of hydraulic fluid are often subject to harsh environmental conditions at a large solar field. Contamination from sand and water can result in expensive maintenance.

**Solution:**  
Parker's icount bottle sampler offers continuous oil monitoring with visual and electrical notification of oil cleanliness levels.

**Customer Advantage:**  
Units are compact and programmable with ISO cleanliness levels; moisture-sensing technology is also available.



### >> AC drives for variable speed solar tracking

**Situation:**  
Most trackers sacrifice performance by operating at only one speed. Tracking too quickly results in lost efficiency. If stowing speed is too slow, it exposes mirrors and frames to unsafe conditions during high winds.

**Solution:**  
Parker variable speed drives can be integrated into solar tracking controls to provide infinite speed control of tracking systems.

**Customer Advantage:**  
Parker variable speed drives are easy to configure and available with common fieldbus protocols to communicate with LOCs and field controllers.



### >> Hydraulic accumulators for CSP and CPV tracking

**Situation:**  
Thermal solar fields and CPV installations require supplemental power to re-position arrays during high wind loads.

**Solution:**  
Hydraulic accumulators can be incorporated into solar tracking systems to reduce load demand on electric motors and provide stored hydraulic power for safe stowing of arrays.

**Customer Advantage:**  
Parker is the global leader in accumulators, offering global engineering and manufacturing support. Integration of a Parker accumulator results in less wear and tear on hydraulic components, a reduction in parasitic electrical power loss, and an economical fail-safe capability.



### >> Multi-tube solar trace for solar heating

**Situation:**  
Residential solar heating requires inlet and outlet connections from the pumping system to the solar receiver. It is advantageous to combine electrical signal wires along with the copper tube and wrap the entire tube assembly inside an insulated jacket.

**Solution:**  
Parker solar trace integrates copper tubing with electrical wiring and wraps the assembly in a UV-resistant insulator.

**Customer Advantage:**  
Installers need to attach only one integrated tube assembly, simplifying installation time and costs. Parker quality ensures that property owners are protected from potential leaks.



### >> Fluid connectors

**Situation:**  
Solar fields can be subjected to extreme environmental conditions, including extreme UV, condensation, rainy seasons, and sand abrasion for a service life greater than 25 years.

**Solution:**  
Parker's advanced plating technology on tube fittings and hose connections provides extended corrosion protection in harsh environments.

**Customer Advantage:**  
Eliminating fitting corrosion reduces the potential of hydraulic leaks and provides the corrosion-free environment that is expected in a solar field.



### >> Guardian® portable filter system

**Situation:**  
Thousands of hydraulic systems installed in a solar field require service and periodic oil replacement.

**Solution:**  
Guardian® portable filter system incorporates a transfer pump and hydraulic filter into one compact, easy-to-use assembly.

**Customer Advantage:**  
Ideal for service technicians. Can be driven out to the solar field and carried by hand. Minimal power requirements and can operate directly from 12 VDC truck power using a small AC inverter.

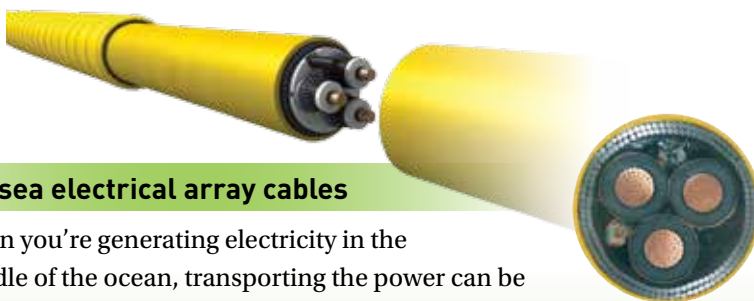




## ENGINEERING YOUR SUCCESS.

Water energy is the power generated by flowing or falling water. Capturing it has traditionally taken the form of hydro dams, pumped storage reservoir installations, or river water wheels which have proven to be efficient and cost-effective ways to produce electricity. Today, work is also being done to harness the mechanical power held in the movement of the ocean with innovative and often unusual wave and tidal turbines.

Whatever the generation method, Parker is there with a wide range of motion and control systems and components. From cylinders that move the wicket gates in hydro dam installations and the array cables that export the electricity from ocean wave turbines to the transformer stations ... to the gearbox lubrication systems on tidal turbine generators and advanced, cooled electrical power conversion systems ... Parker has the experience, products, and technical competence needed to further the science of water energy. As well as the global presence necessary to supply and support its capture.



### Subsea electrical array cables

When you're generating electricity in the middle of the ocean, transporting the power can be a problem, but Parker Scanrope in Norway has a solution. The division manufactures mooring lines that both attach an ocean wave power generation device to the seabed and export its electricity to offshore transformer stations through subsea electrical array cables.

Parker Scanrope has years of experience producing and servicing products for the offshore industry. With its own quay to enable direct loading of the mooring lines and cables to the cable-laying vessels, Parker Scanrope combines expertise with flexibility to best serve its customers.

**INNOVATION  
IN ACTION**

### Micro-hydro: Harnessing the power of small rivers

One of the most traditional methods to harness the power of water is with a water wheel. By transferring the power of flowing water from small rivers into rotational movement and spinning a generator, electricity in the range of 100 KW to 1 MW is produced.

Varying river flows result in inconsistent generator speeds, which prevent the generation of electricity at a constant frequency. Rather than regulating water flow to control the generator speed, a more cost-effective approach is to pass the signal through Parker's power conversion system and produce regulated output at grid frequency.

The core of the power conversion system, Parker's AC890PX inverter provides quality power by incorporating an advanced pulse-width-modulated switching technology, automatically synchronizing to the AC power grid. The insulated gate bipolar transistor-based active bridge bi-directional inverter within the system is actually even capable of delivering full power in either direction within 10 milliseconds, making it ideal for demanding applications like grid frequency stabilization. The efficiency of the inverter exceeds 98%.





# Power Source: WATER

Harnessing power from rivers, waves, currents, and tides.

Look to Parker for:

## Hydro Solutions

- 1 Hydraulic controls for turbines and generators
- 2 Fluid conveyance
- 3 Bearing lube oil system
- 4 Gate actuation

## Wave/Tidal Solutions

- 5 “Wave attenuator” energy converters
- 6 Point absorber
- 7 Paddle style wave harvesters
- 8 Mooring lines and subsea electric cables
- 9 Tidal turbines

## Hydro expertise

Hydropower is the oldest form of renewable energy. From “micro-hydro” to “mega-dams,” Parker engineers design systems ranging from sophisticated hydraulic systems to state-of-the-art controls. Parker systems optimize turbine upgrades and enable OEMs with critical technologies ranging from hydraulics, pneumatics, and electromechanical systems to sealing solutions used inside the turbine. By working with Parker, you’ll benefit from collaborative engineering at the beginning of the project and field support through the entire construction cycle.

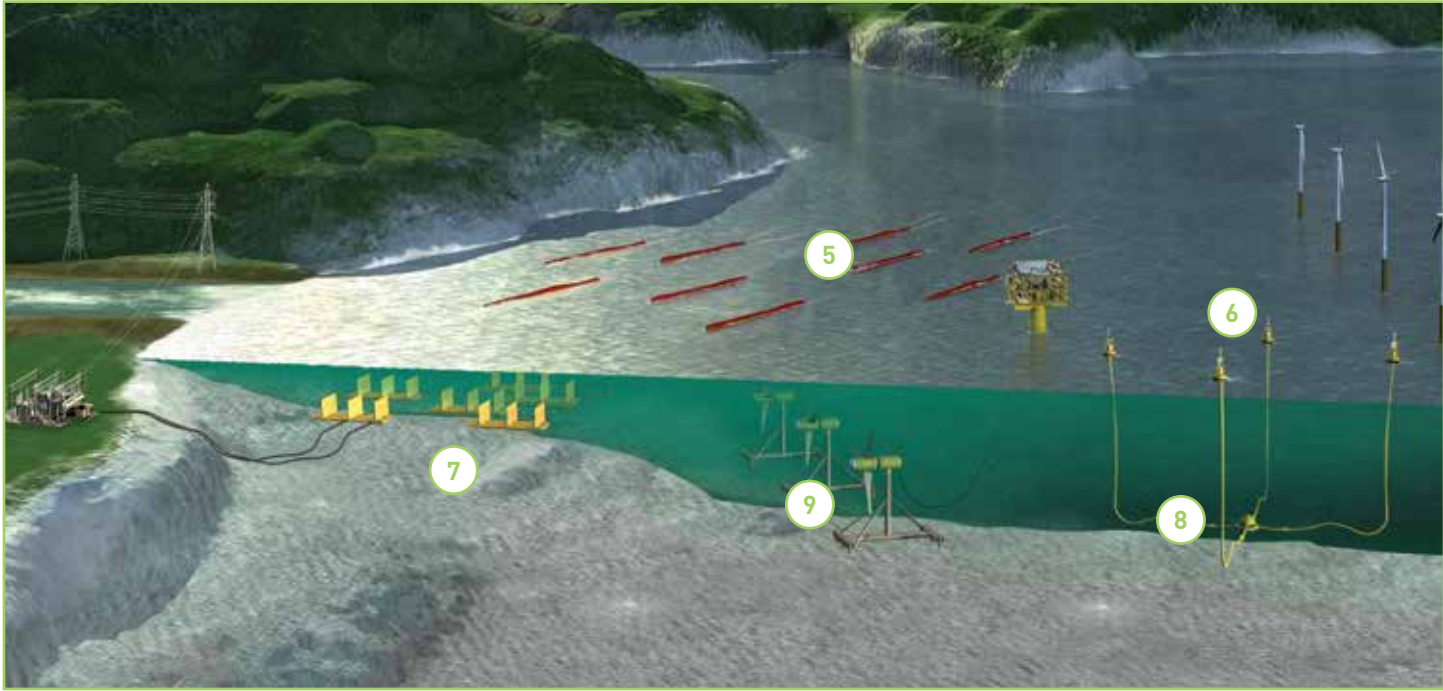
## HYDRO SOLUTIONS



- 1 **Hydraulic controls for turbines and generators**  
Modern turbine governing systems rely extensively on hydraulic systems for high power density and precise position control. Parker’s custom cylinder capabilities and high performance DF Plus proportional valves provide superior control along with robust operation.
- 3 **Bearing lube oil system**  
Bearings used in hydroelectric turbines require clean fluid for trouble-free operation. Parker can provide in-line filtration solutions or complete kidney loops for continuous off-line filtration. We also recommend using Parker reservoir vent filters or isolation systems to prevent the ingress of harmful particles into the lube oil system.

- 2 **Fluid conveyance**  
Parker’s F37 family of non-welded piping solutions reduces potential failure points from traditional welded pipe systems. Parker stainless E02 fittings provide leak-free connections for standard tubes. Parker is also the global leader for medium- and high-pressure hydraulic hoses, available with stainless steel connections.
- 4 **Gate actuation**  
Hydraulics are used to control intake, outlet, flood, and Tainter gates. Parker manufactures highly engineered, custom cylinders to operate gates. We can provide all required plumbing for gate systems with our F37 piping solutions. Parker also has global capabilities to design and build custom hydraulic power units.

## WAVE/TIDAL SOLUTIONS



- 5 **“Wave attenuator” energy converters**  
“Wave attenuator” energy converters ride along the top of ocean waves and harness this motion by allowing hinged sections to pivot around a common axis. This “flapping” motion causes cylinders to extend and retract, creating hydraulic pressure which is then used to drive electrical generators. Parker’s experience and ability to produce highly specialized hydraulic cylinders have proven that Parker is the right provider of motion and control solutions in these state-of-the-art devices.

- 7 **Paddle style wave harvesters**  
Paddle style wave harvesters are mounted to the ocean floor in shallow water. Ocean waves create rotary motion, which is then converted to stored hydraulic energy used for rotating an electric generator. Parker provides custom hydraulic cylinders, accumulators, hydrostatic drives, and a full line of stainless steel fluid connections to enable these novel devices.

- 6 **“Point absorber” wave energy converters**  
“Point absorber” wave energy converters transfer the energy from ocean waves by utilizing vertical oscillations near the ocean’s surface. Linear motion is converted into rotary motion, which in turn drives a generator to produce electrical power. The core of the power conversion system may be either hydraulic or electromechanical and can be designed and built using a vast range of products available from Parker.
- 8 **Mooring lines and subsea electric cables**  
Maintaining the position of wave devices at sea and exporting the electricity generated from the devices to the shore are significant technical challenges. Parker Scanrope’s mooring lines are tried and tested in harsh offshore environments and are known for their high tensile strength and capability to deploy extremely long lengths. Scanrope also excels in the production of low/medium voltage subsea export cables.
- 9 **Tidal turbines**  
Lubrication oil filtration systems (LOFS) are vital for problem-free operation of the gearboxes in many undersea tidal turbines. Parker’s LOFS offer a complete solution for the health management of the gearbox. They not only include the necessary pumps and filters, but also incorporate condition monitoring capabilities to detect changes in the oil quality, allowing ample warning of deterioration to prevent catastrophic failures.



- >> **Specially designed cylinders**  
**Situation:** Hydraulic cylinders are critical components of many hydro installations and ocean devices. They must deliver reliable performance under tough conditions.  
**Solution:** Parker designs and builds special cylinders with longer strokes and larger bores for hydro projects. Whether they use oil or other fluids, or are on land or at sea, Parker cylinders are designed to withstand harsh environmental conditions.  
**Customer Advantage:** You can count on Parker cylinders to deliver the required performance long term. And because the cylinders are designed and built in-house, Parker can supply any needed spare parts for maintenance.



- >> **Fluid connectors**  
**Situation:** The majority of fluid system failures resulting in expensive and unplanned repairs originate from leaking connectors or failed hoses.  
**Solution:** Parker offers the world’s largest selection of approved and tested hose, fittings and couplings. With pressure ratings up to 58,000 psi (4,000 bar) and bore sizes up to 6" (152 mm), Parker has the right fluid connector product for your application.  
**Customer Advantage:** Reliable, leak-free connections are essential to minimize service and protect the environment.



- >> **Grid tie power conversion systems**  
**Situation:** Wave and tidal generators reside in an environment that makes it difficult to carry out maintenance work for on-board electronic and electrical systems. Additionally, the space on board the devices is often limited.  
**Solution:** Installing Parker’s ruggedized grid tie inverter provides a reliable and efficient way to return power to the grid. The self-contained, two-phase liquid cooled loop protects power components from ambient conditions and the modular design provides a scalable solution.  
**Customer Advantage:** The closed-loop cooling system keeps power electronics free from contaminants. Mobile hardened design ensures that vibration and physical shock will not affect the longevity of the inverter’s life.



- >> **Accumulators**  
**Situation:** When hydraulic system stability or reserve power for peak requirements or emergency shutdowns are required, hydraulic accumulators are essential.  
**Solution:** Parker offers a complete range of CE-approved piston, bladder, and diaphragm accumulators that allow high pressure dynamic control of the system.  
**Customer Advantage:** Using Parker accumulators results in reduced system costs through greater system efficiency, longer system life, less noise, and the need for smaller pumps.



- >> **Hydraulic systems**  
**Situation:** In an environment where leveled cost of energy is the overall greatest influencing factor in the success or failure of a project, reliability becomes a critical element. A reliable hydraulic system is a must.  
**Solution:** Using hydraulic systems and power units designed and built by Parker that utilize Parker’s own proven, high quality components assure longest system uptime.  
**Customer Advantage:** Field life is increased, maintenance can be planned, spare part sourcing is easy, and system running costs are kept low.



- >> **DF Plus proportional valves**  
**Situation:** Traditional torque motor style servovalves are commonly used to position governor controls in hydropower turbine speed regulation. Servovalves are especially sensitive to contamination and can experience uncontrolled failure modes.  
**Solution:** Parker DF Plus high dynamic proportional valves are ideally suited for governor controls. Matching high performance with robust operation and controlled failsafe conditions make the DF Plus the best choice for controls. These valves are also available in high flow configurations with an optional external pressure supply port.  
**Customer Advantage:** Provides precise control of wicket gates to optimize turbine speed control using a high performance proportional valve that is both dirt tolerant and has a defined failsafe mode upon loss of power.





ENGINEERING YOUR SUCCESS.

## Expertise that can turn biogas into energy

Originating from biomass, biogas is gaining increasing worldwide importance as a recognized renewable energy source. Biogas production is contributing – and will continue to contribute – to future energy supplies, replacing more and more fossil fuel sources such as coal, oil, and natural gas. Spearheaded by Germany, extensive work undertaken throughout many countries in Europe will lead to the perfection of biogas production. Parker's extensive expertise in the areas of filtration, moisture removal, cooling and drying of bio, sewage, and landfill gases will play an important role in mainstreaming this critical energy resource.

## Hyperchillers cool and dehumidify aggressive bio, landfill, and sewage gases

Parker Hyperchiller bioenergy chillers offer high efficiency performance in aggressive landfill and sewage environments, with special protective treatment on the condensers and copper piping for reliable operation. They are particularly effective when paired with Parker tube bundle heat exchangers and Parker water separators.

These compact chillers have proven to be durable, with excellent reliability and flawless performance under many different operating conditions. Their closed water temperature operation provides high working limits and low running costs. Many options make them highly adjustable for specific operating conditions.

## INNOVATION IN ACTION

### Siloxane removal system improves the profitability of biogas-to-energy projects

Biogas generated in landfills and waste digesters contains siloxane – a man-made chemical that changes into silicon dioxide when combusted. When landfill and digester gases are used to fuel turbines, reciprocating engines, and fuel cells that generate electricity, silicon dioxide buildup due to siloxane significantly increases maintenance costs, reducing the feasibility of these important green energy projects. Parker's siloxane removal system eliminates siloxanes from biogas, reducing maintenance costs and improving profitability for greater cost-effectiveness.





# Power Source: BIOGAS

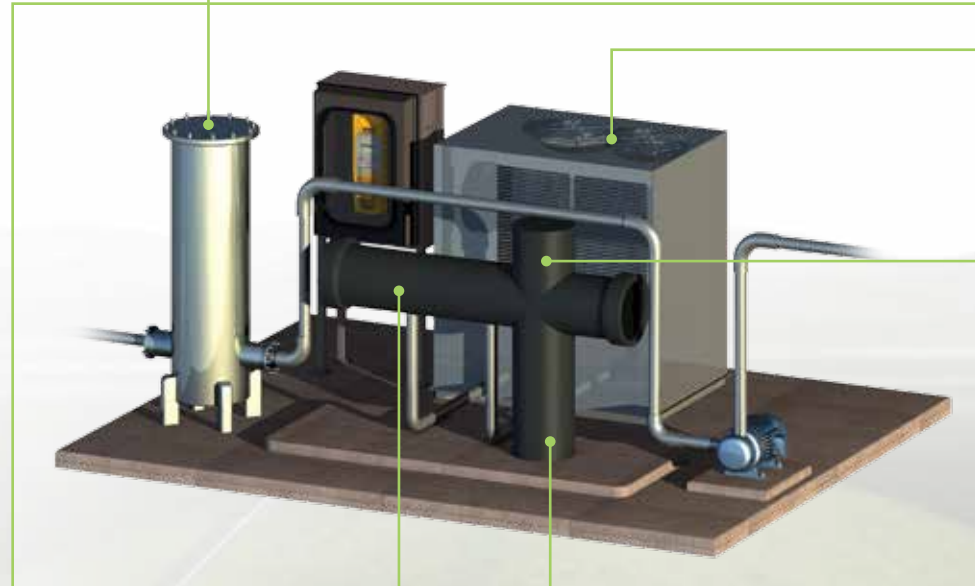
Filling the pipeline with gas

## Look to Parker for:

- 1 Pre- and post-filters
- 2 Tube bundle heat exchanger
- 3 Condensate drain
- 4 Chiller
- 5 Water separator/de-mister
- 6 Energy storage systems
- 7 Pressure swing adsorption (PSA) dryer
- 8 AC drives
- 9 Siloxane removal system

### 1 Pre- and post-filters

Our low-pressure raw biogas filter increases process safety by protecting the tube bundle coolers from dirt and particle contamination. Used as a post-filter, it removes particles from the gas stream, protecting the downstream gas engine.



### 4 Chiller

Our high performance chiller provides chilled water to the heat exchangers to cool down the biogas.

### 5 Water separator/de-mister

With a low pressure differential, our biogas-resistant de-mister efficiently separates water from wet gases, delivering dried gas to protect the downstream gas engine.



### 6 Energy storage systems

Configured to customer and application requirements, these fully integrated systems are easily transported for deployment on site. They typically include a power conversion system and battery banks with thermal management and fire suppression systems.



### 7 PSA adsorption dryer

Regenerative twin tower adsorption dryers ensure that the heated biomethane reaches a pressure dew point between -94° to -130°F (-70° to -90°C) to enable grid injection.



### 2 Tube bundle heat exchanger

Our high efficiency, biogas-resistant tube bundle heat exchanger cools warm gases saturated with moisture to force condensation. It can be used in landfill, sewage, and biogas installations.



### 3 Condensate drain

This mechanical, high capacity float drain is installed at the outlet of a separator/de-mister to drain aggressive condensate from the compressed gas system.



### Siloxane removal system

Our regenerative siloxane removal system eliminates siloxanes from landfill, sewage, and digester gases, reducing maintenance costs and improving profitability for greater cost-effectiveness.



### 8 AC drives

Parker AC drives control cooling systems, fans, and pumps. The application of variable frequency drives to traditional fixed speed applications, such as in pumps, fans, and compressors, can yield up to 30% energy savings. In fact, many power utilities and government agencies provide financial incentives to invest in variable frequency drive technology.



## >> Biogas filters



**Situation:** Gas unit manufacturers demand purity of the combustible gas feeding into their units.

**Solution:** Filtration upstream of the gas unit combustion chamber.

**Customer Advantage:** Parker's highly efficient and proven filters purify gas, providing maximum process safety and ensuring the extended life of the downstream gas unit. Parker filters are available with various element grades, offering a wide range of choices to meet customer requirements.

## >> Adsorption dryer



**Situation:** Grid injection of treated biogas (biomethane) requires compliance with various country-specific criteria, including dehumidification.

**Solution:** Parker's adsorption dryers ensure reliable gas dehumidification, achieving pressure dew points of -94° to -130°F (-70° to -90°C).

**Customer Advantage:** Parker's regenerative twin tower adsorption dryers ensure economic gas dehumidification and low pressure dew points. The twin tower design facilitates continuous operation, providing optimum energy balance and maximum safety.

## >> Biogas chilling system (skid)



**Situation:** Raw biogas contains impurities and moisture that must be removed before use in gas motors or turbines. However, on-site installation of individual gas treatment pre-filters, coolers, and separators is both time-intensive and cost-prohibitive.

**Solution:** Parker's skid-mounted biogas chilling system is an integrated solution of proven components ready to be connected to the local biogas network.

**Customer Advantage:** Installing a ready-to-use, all-in-one skid saves both time and money.

## >> PTFE hose



**Situation:** Due to high and varying temperatures, as well as residue buildup and media contamination, the service life of biogas hoses is often compromised.

**Solution:** Parker PTFE hose. Available with a smooth inner bore for minimal pressure loss, reduced residue buildup, and no media contamination, or ridged for superior flexibility.

**Customer Advantage:** Parker PTFE hose maximizes service life. Its superior design reduces service intervals and improves failure rates. What's more, PTFE hose can withstand temperatures up to 446°F (230°C).

## >> A-LOK® tube fittings



**Situation:** Two-ferrule design fittings with traditional hardening technology are susceptible to environmental corrosion.

**Solution:** Parker A-LOK® fittings with Supracase®, specifically designed for use on instrumentation, process and control systems, analyzers, and environmental equipment.

**Customer Advantage:** When hardened with Parker Supracase, A-LOK's rear ferrule resists inter-granular corrosion, creating tube fittings that offer superior sealing and performance in demanding corrosive environments.

## >> Parflange® F37 connections



**Situation:** Welded tube connections for piping systems is both time-consuming and expensive.

**Solution:** Parker Parflange® F37 non-welded connectors can be prefabricated and installed in less than half the time of field welded piping.

**Customer Advantage:** The Parflange F37 system reduces installed cost by reducing welding and fabrication time, and lowers maintenance time for flushing. This advanced non-welded technology is further supported by Parker's Complete Piping Solutions Centers, which offer turnkey advice, design, pre-assembly, delivery, and installation for single-source solutions designed to maximize customer profitability.



# ENERGY STORAGE

## Utility scale battery energy storage systems; Advanced thermal management technology

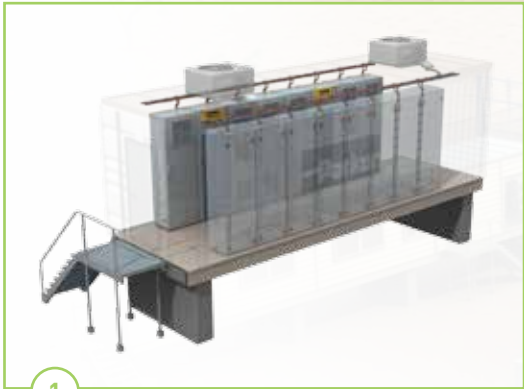
Parker offers a full range of solutions for utility scale battery energy storage, from bidirectional grid tie inverters to outdoor duty power conversion systems to climate-controlled battery containers. The product of more than 35 years of power conversion experience, our grid tie inverter systems reliably charge battery banks during periods of low demand, and efficiently discharge them to the supply grid at a constant frequency as needed, while delivering exceptional power quality. Energy storage systems are often integrated with renewable energy sources such as solar and wind farms, but when combined with traditional generating sources, can provide benefits of lower emissions, better grid stability, and lower fuel consumption.

### Applications:

- Frequency regulation
- Integration of renewables
- Micro-grid solutions
- Power factor control/volt-ampere reactive (VAR) support
- Ramp rate control
- Transmission and distribution (T&D) upgrade deferral
- Spinning reserve
- Black start

### Look to Parker for:

- 1 **Bidirectional grid tie inverters**
- 2 **Integrated energy storage/ battery containers**
- 3 **Outdoor duty power conversion systems**
- 4 **Thermal management for battery containers and power electronics**



1

#### Bidirectional grid tie inverters

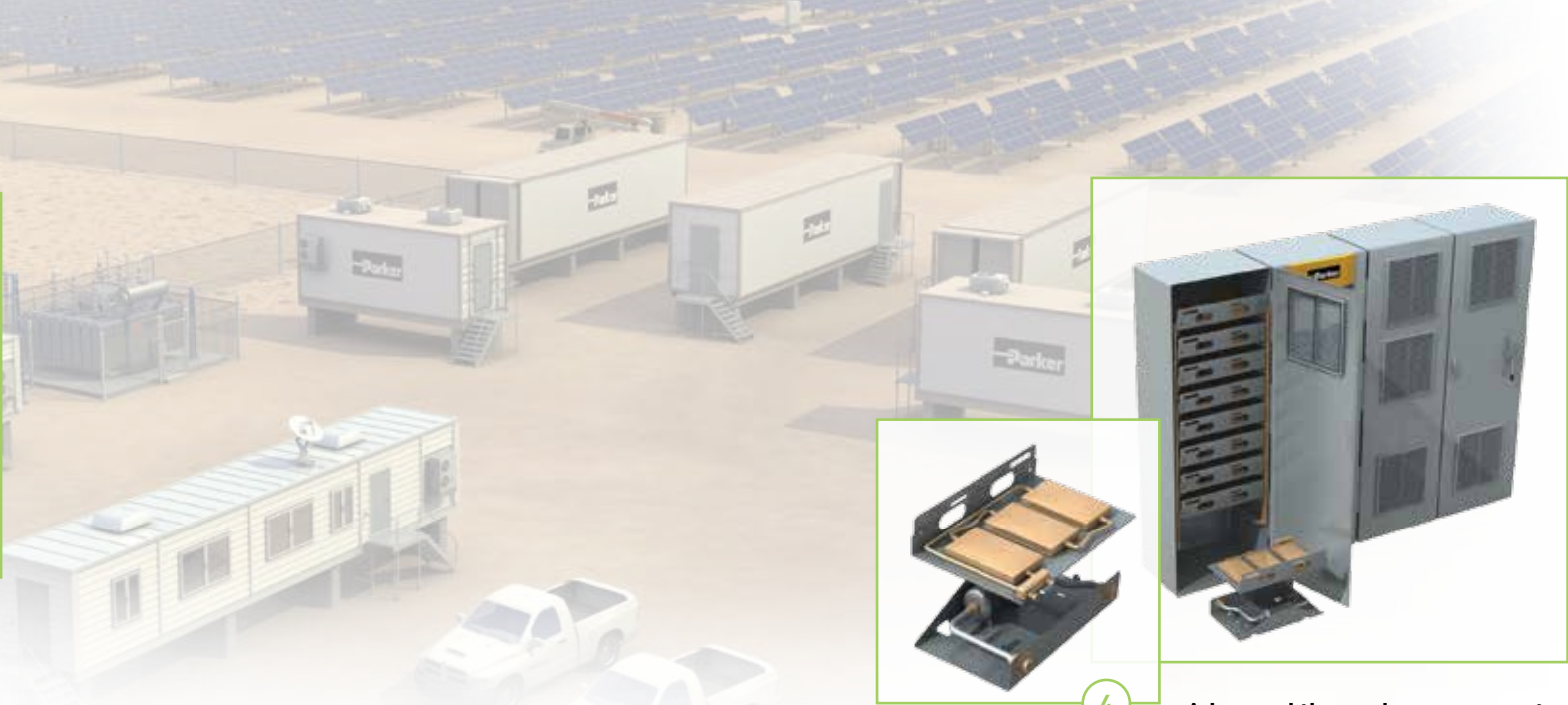
At the heart of an energy storage power conversion system is the grid tie inverter. Parker manufactures a modular solution with proven efficiency and uptime. Designed to be easily maintained and serviced, the inverter racks deliver high power density and a small footprint, and feature highly efficient two-phase evaporative liquid cooling technology.



3

#### Outdoor duty power conversion systems

Parker provides outdoor-rated power conversion systems in sizes and ratings to suit applications from micro-grid to full utility scale. All enclosures are easily transported, deployed, and commissioned, and can be specified for the most extreme environmental conditions.



2

#### Integrated energy storage/ battery containers

Configured to customer requirements for a variety of different battery systems. Parker delivers turnkey containers that include adaptive climate control, fire suppression systems, lighting, container hardening, battery racks, safety agency approvals, and tie-ins to power conversion systems.



4

#### Advanced thermal management for power electronics

Parker offers advanced two-phase "evaporative" liquid cooling technology to efficiently cool power electronics, using a modular cold-plate design for use with any inverter. The technology's inherent efficiency can enable up to twice the density and can provide up to a 40% increase in power throughput from existing electronics, in a safer, more reliable solution.

### Advanced, refrigerant-based cooling

Our advanced thermal management technologies are key to our ability to offer efficient, cost-effective energy storage and power conversion. Specifically, with two-phase evaporative precision cooling, Parker has been able to cool the full range of wind and solar power generation systems, delivering up to a 40% increase in throughput and more than twice the power density, significantly reducing the overall space requirements for power conversion and grid tie systems. This closed loop, advanced cooling system uses a non-conductive, non-corrosive refrigerant that vaporizes on contact with hot electronics and cools more efficiently than any other air or water based system.

INNOVATION  
IN ACTION

### >> Energy storage system

#### Situation:

Renewable sources of power may be cyclic or unpredictable, making them difficult to integrate with the power grid. Power may be generated when demand is low, but not during times of peak demand when it is most needed.

#### Solution:

Utility scale energy storage can provide capacity firming, using energy stored in batteries to support the grid during peaks, and absorbing energy when the grid is at capacity. The capability to store energy can also eliminate curtailment or dumping of renewable energy when it is plentiful, but not demanded.

#### Customer Advantage:

Maximizes the net output of a wind or solar power installation, increasing revenue for the owner/operator.

#### Situation:

Conventional power plants are required to maintain overload capabilities for periods of peak demand. Overload capabilities often include spinning reserve, fossil fueled generating resources that are kept idling even when not called for.

#### Solution:

Utility scale energy storage can provide for the reserve capacity, without burning fuel or producing emissions. With sub-cycle response time and high round trip efficiency, the energy storage system can take the place of traditional reserves.

#### Customer Advantage:

Satisfies requirements for overload capacity with less fuel used plant-wide, less emissions produced, and no moving parts requiring maintenance.

#### Situation:

A projected increase over time in power usage will eventually make existing power transmission and distribution lines the "weak link" between power plant and customer. In time, if the power demand continues to increase as anticipated, it will require a costly upgrade in transmission hardware.

#### Solution:

Utility scale energy storage can be quickly deployed near the load to reduce peak demands on the existing power lines. This resource addition can defer a major expense for a period of time. Parker's containerized solution can be easily relocated once the upgrade is completed.

#### Customer Advantage:

Expense to upgrade transmission line capacity is deferred.





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