

# 59EI Gas Turbine, Reciprocating Engine Supplier Program

Designed to assist management in strategy decisions and sales people with identification of opportunities while also creating a new route to market.





# McIlvaine's Gas Turbine Subscription Service

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## Market Forecasts

- MW Forecasts by country and year
- *Sales forecasts for specific products such as intake filters, SCR equipment, valves & pumps*

## Databases

- Existing Gas Turbine facilities worldwide with detailed information regarding gas turbine equipment, HRSG manufacturer, NOx control equipment and other information
- Proposed Gas Turbine facilities worldwide, including those under construction, in planning and permitting phase, and even those which have been cancelled or are on hold

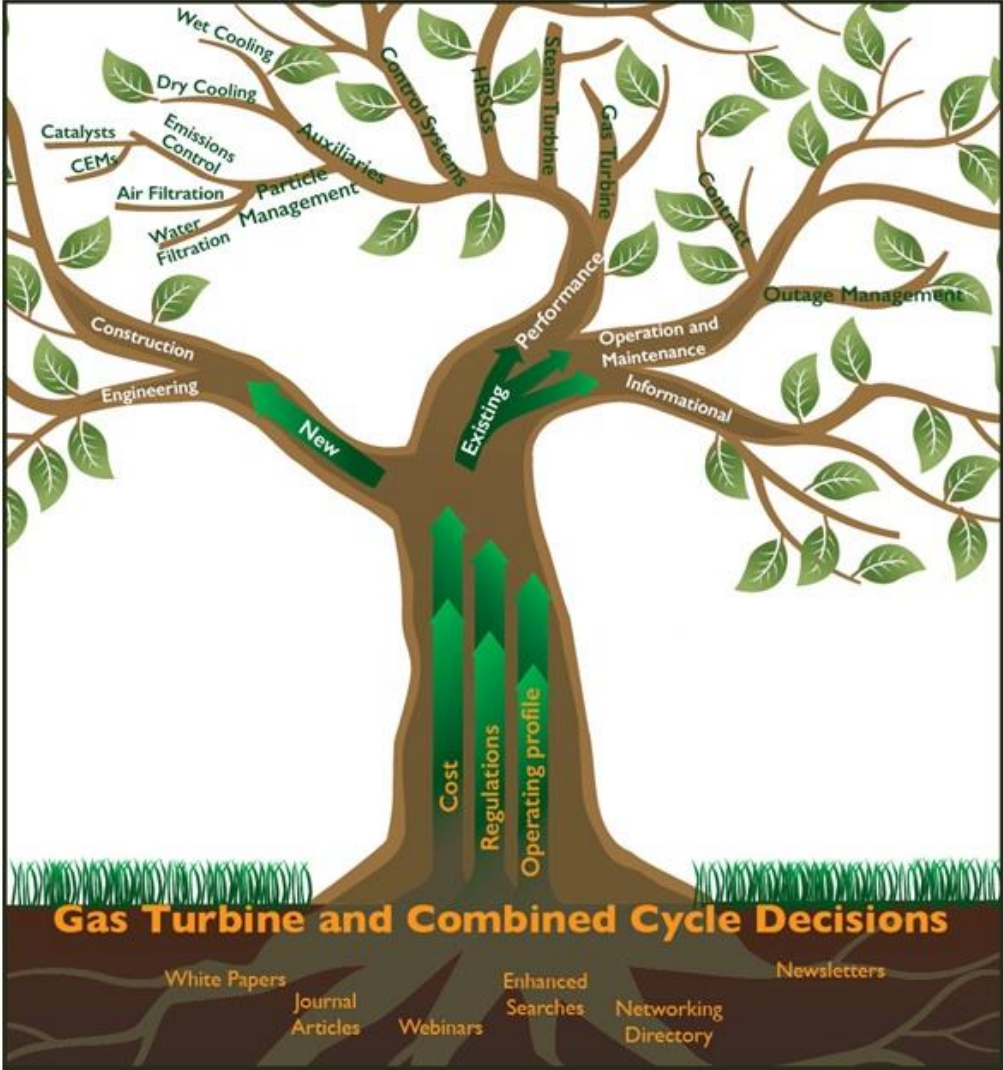
## News and Updates

- News regarding Gas Turbine projects worldwide – every 2 weeks with technology update on alternate weeks
- Business related news such as acquisitions, strategic business changes (such as Engie's divestment of assets) and regulatory developments
- Highlights of all new projects as they are added to our database
- Special topics and analyses
  - IIoT and Remote Monitoring
  - Gas engines to provide heat, light and CO2 for greenhouses
  - Data center emergency power converted to standby

# Gas Turbine Product and Service Market Coverage

Forecasting each gas turbine-combined cycle and reciprocating engine product and service while identifying all the plants and projects insures better accuracy for any individual product forecast.

The analysis of new technology is essential to determining future markets. Digital tools such as webinars provide the opportunity for cross pollination of insights from end users and suppliers. A Decision System for end users is a critical segment of the program.





## **This Program will help Address the Paradigm Shift caused by IIoT and Remote Monitoring**

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- The gas turbine industry is leading the way in the new world of the Industrial Internet of Things (IIoT) and remote operations and maintenance.
  - If you sell turbine systems, you will increasingly be selling packages with remote O&M services.
  - If you sell components you will be selling to third party O&M operators.
  - If you sell valves and pumps you will be selling smart versions and will have remote monitoring contracts.
  - If you sell software and instrumentation you will be selling to a wide range of customers who are identified in this supplier program.
  - The information avalanche generated by IIoT will only be valuable to the extent IIoT is married to IIoW (the Industrial Internet of “Wisdom). Knowledge rather than salesmanship will be the key to success.
  - This supplier program is your guide to this new world
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# Example of Biweekly Alert

## U.S. GAS TURBINE PROJECTS

- NRG Completes Four Coal to Gas Projects and Continues Fleet Optimization Strategy
- CALIFORNIA: Ares EIF to Sell Pio Pico Energy Center
- MICHIGAN: EthosEnergy awarded Seven-Year Contract for Operations Maintenance Services by Rockland Capital
- NEW YORK: Siemens to supply Additional Aero-Derivative Gas Turbines to help Power New York City
- PENNSYLVANIA: Ameresco and PIDC Partner on an Innovative Project at the avy Yard in Philadelphia

## WORLD GAS TURBINE PROJECTS

- CHINA: MHPS Wins Order to Provide Gas Turbine Preventive Detection Services in China

## RECIPROCATING ENGINE PROJECTS

- ARGENTINA: Wärtsilä to supply a 101 MW Power Plant to Argentina  
U.S. VIRGIN ISLANDS: APR Energy Awarded LPG-Fired Project in U.S. Virgin Islands

## BUSINESS

- Sulzer to Acquire Control of Rotec's Gas Turbine Service Business Mitsubishi Hitachi Power Systems Unveils Revolutionary JAC Gas Turbine

## MARKETS

- Gas Turbine Owners Will Spend \$313 Billion for Equipment, Repairs and Service Next Year

# Monthly GTRE Update

## SOFTWARE

- New GE Analysis: Software and Hardware Upgrades could cut Global CO<sub>2</sub> Emissions from Coal and Gas Power Plants by 1 Billion Metric Tons
- ABB Champions the Power of Intelligent use of Plant Data at Power-Gen Asia
- **RECENT POSTINGS IN GRTE DECISIONS**
- 
- More Efficient Filters are justified says Carlos Conti of Vokes
- Colfax Oil Pumps for Power Generation
- Richard Winslow is a Niche Expert on Power Plant Lubrication
- Bacterial Contamination of Turbine and Circulating Lube Oil Systems
- Interconnecting Compressor Initiatives at BHE
- Mann & Hummel spin-on Filters are used for the Filtration of Lube Oil
- BHE -Safety Relief Valves needed by Many BHE Plants

## O & M CONTRACTS

- Wood has O&M contract for Bethel Energy Centre
- ProEnergy renews Contract with Ameren for O&M at GTCC Facilities
- IHI has a Range of O&M Services for Power Plants
- MHPS combining OSIsoft Monitoring Software with Cloud-based Analytics in Strategic Alliance
- Nalco providing 24/7 Water Monitoring for Gas Turbine Plant
- Ansaldo is Remotely Monitoring 17,000 Sites

## EQUIPMENT

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- Clarocor has 5 Step Plan to Help Turbine Operators Select Filters
- MHPS has New Enhanced Air Cooled Gas Turbine



# Projects Updated on November 26, 2016

Project Title	First Entry Date	Location	Startup date
Porto de Sergipe CCGT - Golar Power	10/24/2016	Brazil	2020
Hattar CCGT - Khyber Pakhtunkhwa Economic Zone Development Co	8/9/2016	Pakistan	2017
Soma Port CCGT - Fukushima Gas Power	11/14/2014	Japan	2020
Heartland CCGT - ATCO Power	10/1/2013	Canada	2022



# Details on GTCC in each Country

Afghanistan - Ministry of Energy and Water  
Albania - Korporata Elektroenergjitike Shqiptare  
Algeria - Algerian Energy Co  
Algeria - New Energy Algeria (NEAL)  
Algeria - Sharikat Kahraba Berrouaghia (SKB)  
Algeria - Sharikat Kahraba Hadjret En Nouss  
Algeria - Shariket Kahraba Skikda (SKS)  
Algeria - Shariket Kahraba Terga (SKT)  
Algeria - Shariket Karhaba Koudiet Eddraouch (SKKE)  
Algeria - Sonelgaz Production de l'Electricite  
Angola - Empresa Nacional de Electricidad  
Argentina - AES Argentina  
Argentina - Albanesi  
Argentina - Albanesi S.A.  
Argentina - Aluar Aluminio  
Argentina - Capex SA  
Argentina - Central Vuelta de Obligado SA (CVOSA)  
Argentina - Centrales de la Costa Atlantica SA  
Argentina - Centrales Termicas NOA SA  
Argentina - Centrales Termicas Patagonicas SA  
Argentina - Empresa Provincial de Energia de Cordoba

Argentina - Energia del Sur SA  
Argentina - ENERSA  
Argentina - Fideicomiso Central Termoelectrica  
Argentina - Foninvemem  
Argentina - I Sqared Capital  
Argentina - Pampa Energia SA  
Argentina - Petrobras Electricidad  
Argentina - Pluspetrol SA  
Argentina - Sociedad Argentina de Energia SA  
Argentina - Tenaris  
Armenia - GazProm  
Armenia - Yerevan Thermal Power Plant CJSC  
Australia - AGL Corp  
Australia - Alcoa of Australia  
Australia - Alinta Energy  
Australia - Anaconda Nickel Ltd  
Australia - Arrow Energy  
Australia - ATCO Power Australia





## Decision Makers in U.S. - Existing Plants

Details are provided relative to each unit at each plant. You can search by the owner and view all the plants he operates with details on the equipment installed at each.

### Largest Gas Turbine Power Producers in the U.S.

Based on Capacity as of the end of 2015

Rank	Power Producer	Gas-Turbine Power Production		
		Total Capacity (MW)	Number of Facilities	Total Number of Units
1	Calpine	27,894	63	190
2	Duke Energy	25,061	42	242
3	NextEra Energy	20,735	18	132
4	Southern Co	19,919	30	138
5	NRG Energy	18,946	57	238
6	Dynegy	14,022	23	96
7	TVA	12,201	15	118
8	Berkshire Hathaway	11,812	24	107
9	Engie	10,260	19	57
10	LS Power	9,492	17	70



# Decision Makers in U.S. - New Plants

## Largest Gas Turbine Power Developers in the U.S.

Rank	Power Producer	Gas-Turbine Power Projects	
		Total Capacity (MW)	Number of Facilities
1	<b>Panda Power Funds</b>	5,206	6
2	<b>Dominion</b>	2,958	2
3	<b>Exelon</b>	2,400	3
4	<b>Competitive Power Ventures</b>	2,075	3
5	<b>Advanced Power</b>	1,742	2
6	<b>Duke Energy</b>	1,640	1
7	<b>Coronado Power Ventures</b>	1,400	2
8	<b>NTE Energy</b>	1,290	3
9	<b>NextEra Energy</b>	1,277	1
10	<b>PSEG</b>	1,275	2

These are the largest power producers based on the capacity of proposed gas turbine power projects which are currently still on track – either in the approval or permitting process or currently under construction.

Half of the top ten are private equity or private investment companies which develop merchant power plants in deregulated markets with a profit motive.

Utilities such as Duke Energy operate only regulated plants, where rates are set through ratemaking proceeding

- Their motive is still profit, but income is effectively capped by the set rate
- Operating cost effectiveness become the key to profit



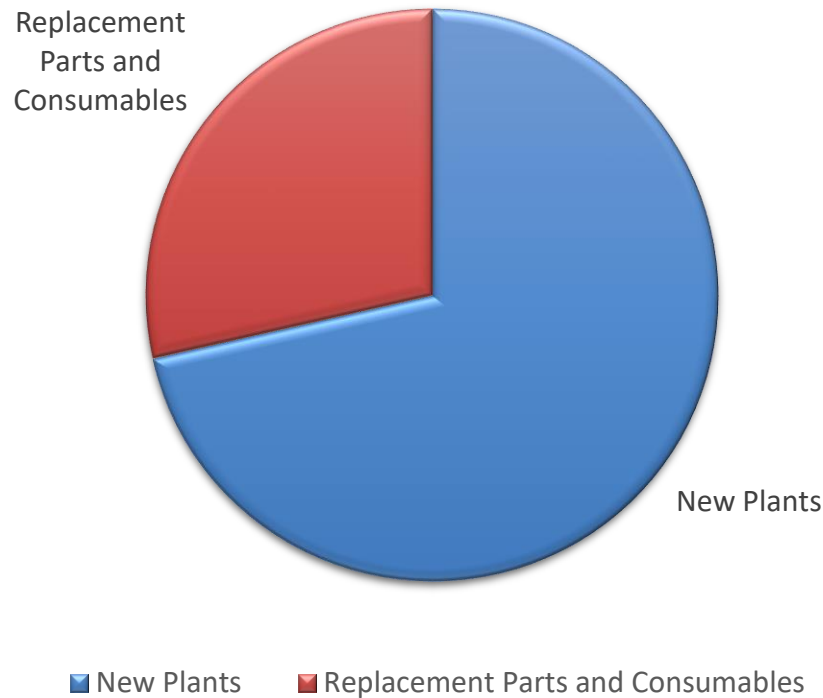
# Japan Forecast of GTCC in MW

Classification	2016	2017	2018	2019	2020	2021
Total	52,939.00	55,439.00	57,939.00	60,439.00	62,686.00	64,936.00
Existing	51,552.00	52,939.00	55,439.00	57,939.00	60,439.00	62,686.00
New	1,387.00	2,500.00	2,500.00	2,500.00	2,247.00	2,250.00

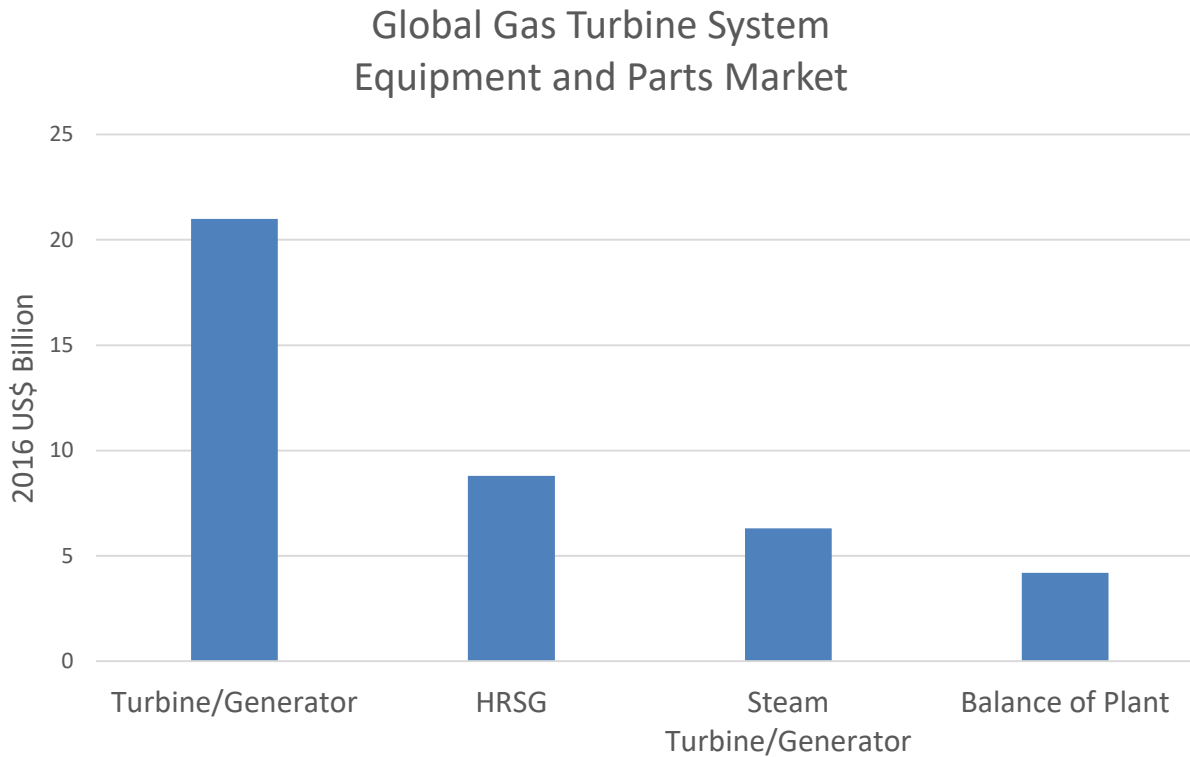
Forecasts for 80 countries and sub regions are continually updated. They are also aggregated by region and continent.

# New vs Consumables and Repairs

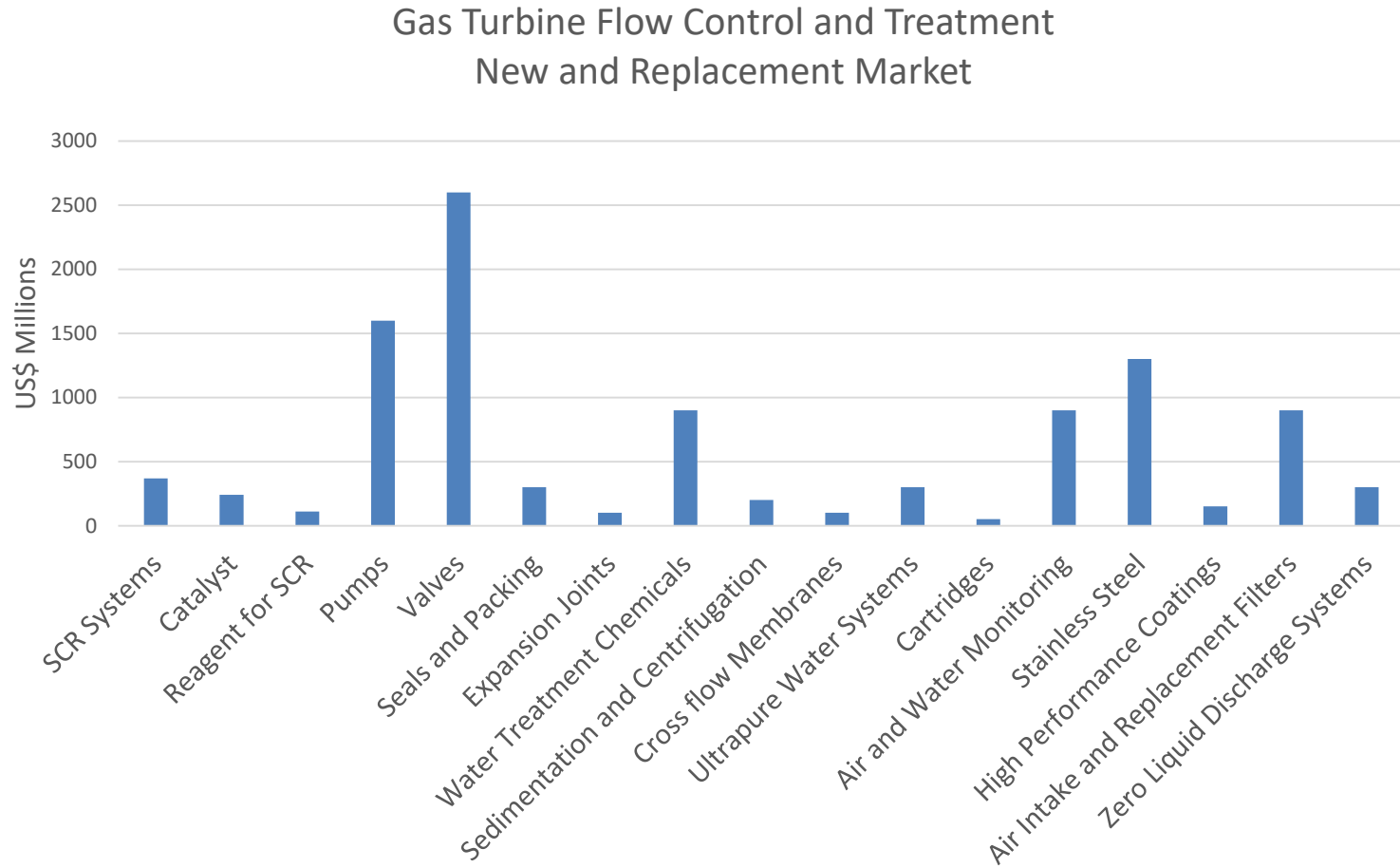
## Gas Turbine Parts vs Consumables



# Market Segmentation by Major Component



# Valves and Pumps Lead Component Purchases



# Drivers Impacting Product Markets

Product	Driver	Market Impact
Air Intake Filters	Higher efficiency for turbine protection	Could boost market by 50%
SCRs	Regulations in Europe and elsewhere	Big increase in market where required.
Pumps	FAC and other cycling challenges	Market growing faster than total GT market.
Valves	FAC and other cycling challenges	Market growing faster than total GT market.
Seals	Pump, valve, compressor and new turbine designs	Market growing faster than total GT market.
Zero Liquid Discharge (ZLD) Systems	Regulations, aridity and reluctance to wait for water permits	Growing market in U.S., China and elsewhere.
Stainless Steel	New turbine designs	Continuing opportunity for high performance materials.
Steam Turbines	Addition of steam turbine to existing peakers to meet energy and greenhouse gas goals	Substantial market impact as many plants are upgrading.
HRSBs	Fast start needed	New design needed.

# Regulatory Drivers

Pollutant	Driver	Market Impact
Greenhouse Gases	Limits or penalties on CO <sub>2</sub> emissions	Negative impact on market vs. renewables but positive vs coal
Harm to Aquatic Life	Regulations forcing less intake and less once through water	ZLD, dry cooling, municipal water reuse
Water Discharge Limits	U.S. has new regulations	More ZLD
NO <sub>x</sub> Emissions	Tough regulations in U.S. and potential new regulations in Europe	Steady positive impact on SCR and urea markets as prices are lowered in various countries





# Components at One Plant

## Chuck Lenzie Generating Station

- **Commercial operation:** Power block 1, January 2006; power block 2, March 2006  
**EPC contractor:** Fluor Energy & Chemicals Group  
**Owner's engineer:** Washington Group International (now part of URS Corp)  
**Type of plant:** Combined cycle (two 2 x 1 power blocks)  
**Key personnel**  
**Regional director:** Tom Price  
**Asst regional director:** Brian Paetzold  
**Operations manager:** Forrest Hawman  
**Maintenance manager:** Dave Hall  
**Plant engineers:** Shane Pritchard, Andy Gaither  
**Environmental manager:** George Brewer  
**Safety manager:** Ernie Wilson  
**Gas turbines**  
**Manufacturer:** GE Energy  
**Number of machines:** 4  
**Model:** 7FA (PG7241)  
**Control system:** Mark VI  
**Combustion system:** DLN 2.6  
**Fuel:** Gas only  
**Water injection for NOx control?** No  
**Water injection for power augmentation?** No  
**Air inlet house:** GE Energy  
**Air filters:** Donaldson Company Inc  
**Inlet-air cooling system, type:** Chiller  
**Generator, type:** Hydrogen-cooled  
**Manufacturer:** GE Energy  
**GSUs:** Alstom  
**HRSGs**  
**Manufacturer:** Aalborg Industries (now CMI EPTI LLC)  
**Control system:** DeltaV (Emerson Process Management)
- **Duct burner:** Coen Company Inc  
**SCR:** Peerless Mfg Co  
**CO catalyst:** Englehard Corp (now BASF Catalysts LLC)  
**Water treatment**  
**HRSG internal treatment, type:** AVT  
**Chemical supplier:** Nalco Co  
**Reverse osmosis system:** Aquatech International Corp  
**Demineralizer:** Aquatech International Corp  
**Cooling-water treatment system:** Aquatech International Corp  
**Cooling-water chemical supplier:** Nalco Co  
**Wastewater treatment system, type:** ZLD  
**Steam turbine**  
**Manufacturer:** GE Energy  
**Number of machines:** 2  
**Model:** D11  
**Generator, type:** Hydrogen-cooled  
**Manufacturer:** GE Energy  
**GSUs:** Alstom  
**Balance of plant**  
**DCS:** DeltaV (Emerson Process Management)  
**Condenser, type:** Air-cooled  
**Manufacturer:** GEA Power Cooling Inc  
**Wet cooling towers:** Baltimore Aircoil Co  
**Boiler-feed pumps:** KSB Inc  
**Condensate pumps:** Flowserve Corp  
**Circulating-water pumps:** Flowserve Cor

# Operating ZLD Systems from McIlvaine GTCC Supplier Program

Operating Facilities	ZLD Supplier	Location	Size (MW)	Startup
Altamonte – Edison	Degremont	Italy	757	2006
Colusa – Pacific Gas & Electric		California	712	2010
Jack County – Brazos Electric	Aquatech	Texas	620	2011
Magnolia – City of Burbank		California	387	2005
Sherman – Panda Power	GE	Texas	750	2014
Red Hawk – Arizona Public Service	Veolia	Arizona	1,060	2002
Riverside – City of Riverside		California	96	2011
Rocky Mountain – Xcel		Colorado	705	2004
Roseville – City of Roseville		California	162	2007
Russell City – Calpine		California	635	2013
Temple – Panda Power	GE	Texas	760	2014



# New ZLD Projects from McIlvaine GTCC Supplier Program

Project	Location	Size (MW)	Expected Startup
Bowie CCGT - Southwestern Power Group	Arizona	500	2016
Stonewall CCGT - Green Energy Partners/Panda	Virginia	778	2017

A large number of ZLD systems are anticipated for the arid areas of the Middle East and China but also for areas with plentiful water where there is difficulty or delay in obtaining water discharge permits. Local cities, states, and provinces often have tougher limits than the national standards.



# ProEnergy is one of Many Third Party O&M Firms and the Trend is Accelerating

- In September 2016 ProEnergy was awarded a contract renewal for the operations and maintenance of five Ameren Missouri facilities including Goose Creek Power Plant, Raccoon Creek Power Plant, Kinmundy Power Plant, Pinckneyville Power Plant and Audrain Power Plant. Under these contracts, ProEnergy will continue to provide site management, planning, scheduling and maintenance services.

The Goose Creek Power Plant, located near Monticello, Illinois, is a 450 MW facility consisting of six GE 7EA combustion turbines. Raccoon Creek Power Plant is a 300 MW facility located near Flora, Illinois, operating four GE 7EA combustion turbines. Kinmundy Power Plant, near Patoka, Illinois, is operating two W501D5A combustion turbines with a generating capacity of 234 MW. Pinckneyville Power Plant in Perry County, Illinois has a generating capacity of 320 MW, operating four GE LM6000 and four GE 6B gas turbine generators. The Audrain Power Plant is located in Vandalia, Missouri and has a generating capacity of 600 MW, consisting of eight GE 7EA combustion turbines.

- ProEnergy is responsible for the construction, management, operations, maintenance, and repair services for energy generation facilities and equipment around the world. ProEnergy has U.S. offices in Sedalia, Missouri; Houston, Texas; and Fort Collins, Colorado; and international locations in a number of countries including Canada, Argentina, Venezuela, Brazil, Panama, Pakistan and Angola.



# IHI has Flexible Suite of O & M Services

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- IHI Power Services Corp. (IPSC) supports power plant owners with a flexible suite of operations & maintenance services.
  - IPSC acts as a third-party operator to help plant owners achieve the full economic potential of their plant resources. IPSC is built to provide U.S. power generators with experienced professionals who can utilize their years of hands-on power industry experience to ensure optimal the operation of power plant fleets. An example of the company's power plant operations & maintenance services is their training guidance. The company's experts work with plant teams to ensure they are committed to and capable of meeting the industry's best practices. Through customized training programs aligned with the client's plant objectives, the IPSC team guides plant workers on their roles within the organization. It's a service that assures companies of consistently productive working environments and focused personnel.
  - IPSC also has experience in the area of maintenance planning. Their team can help plant operators understand the costs of shutdowns and mitigate these costs utilizing set maintenance program. The IPSC staff crafts customized maintenance programs for plant operators designed to take into consideration the current market environment and the potential long-term operational issues the company may face regarding their equipment. This expert planning guidance empowers proactive decision-making and helps prevent shortfalls in productivity due to unexpected plant downtime.
  - Another key area in which IPSC specializes is staffing. Because of the company's experience at the helm of a large number of power plants, they have developed an understanding on plant staffing requirements.
-