RESOLUTE RESEARCH

THE PUMP MARKET REPORT

2017-R1

THE PUMP MARKET REPORT

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The Pump Market Report is one of the three products within the pump portfolio. Information used in tables/graphs are derived from the Pump Supplier Data Base and Pump Product Data Base. These data bases are separately available.

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FOREWORD

Resolute Research thanks you for purchasing The Pump Market Report. In this report, every effort has been taken to maintain a disciplined research methodology to ensure high data integrity and supportable market insights. It is our expectation that this report will be a valuable component of your strategic planning activity now and into the future.

Methodology of Report

Market Sizing
Critical to any market research is an accurate top-level assessment of the Total Available Market (TAM). This report uses a "sum-of-sales" analysis of hundreds of individual pump manufacturers to determine total worldwide pump revenues based on actual pump company pump sales.

Pump Segmentation
Total pump sales are comprised of different kinds of pumps including centrifugal, lobe, gear, vane, piston, diaphragm, peristaltic, progressing cavity, screw, and others. This report segments pump sales by pump type based on research of the pump companies described in the sum-of-sales analysis. This provides a reliable manufacturer-based segmentation of pump sales by pump type.

Geographic and Industry Segmentation
Clear assessment of industry and geographic segmentation of pump sales is critical to corporate strategic planning. This report utilizes detailed process flow diagrams to define template applications such as power plants, water treatment plants, wastewater treatment plants, desalination plants, refineries, pulp & paper plants, and other industrial plants to accurately profile the type, number, and value of pumps within each plant. This template information is then combined with information on the number of existing plants and planned new-builds within each geographic area to provide a forecast for new and aftermarket pump sales by country, industry, and pump type.

What this Means
These research methodologies contribute to a sound assessment of pump markets and opportunities with the degree of pump segmentation necessary for most clients.

Scope of Report

Pump Types: centrifugal, piston, screw, progressing cavity, diaphragm, vane, lobe, internal gear, external gear, peristaltic, metering, and artificial lift.

Pump industries: oil & gas, refinery, petrochemical, chemical, power, metals & mining, pulp & paper, food & beverage, pharmaceutical, semiconductor, water & wastewater, desalination, marine, and general industrial.

Pump Geographic Markets: 64 countries covering 96% of world GDP.

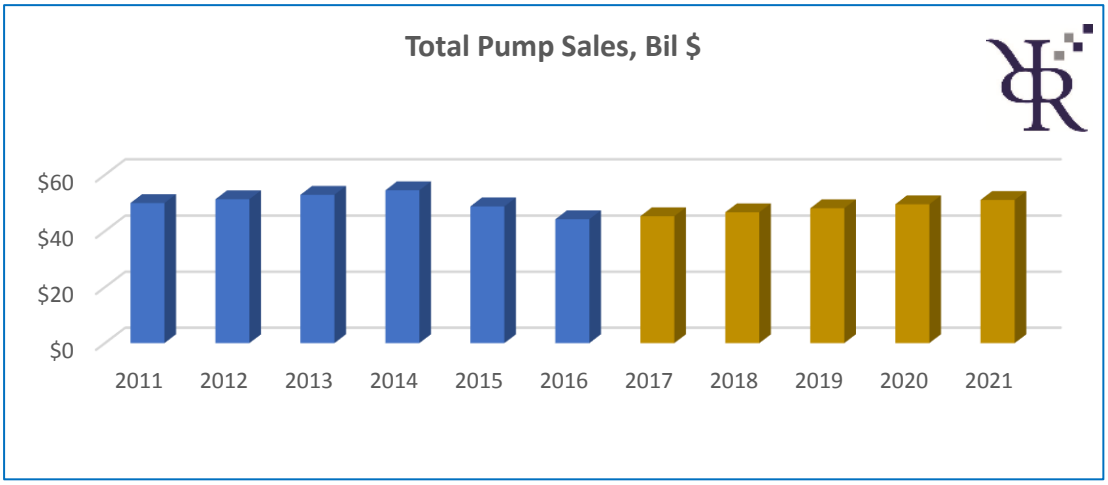
Pump suppliers: hundreds of pump manufacturers, worldwide.

Narrative: analysis of pump technologies, applications, markets, suppliers, OEMs, distributors, EPCs, trends, drivers, and forecasts.

EXECUTIVE SUMMARY

Worldwide **pump revenues** were approximately $44.1-billion in 2016, as determined by a sum-of-sales rollup of pump company pump sales. This represents an approximate 9.6% decrease from pump sales of approximately $48.8-billion in 2015. The collapse in crude oil pricing and upstream CapEx that began in the second half of 2014 was a major factor in the more than 10% reduction in pump sales in 2015, and carry over of continued significant pump sales losses into 2016 as well. The reduced sales were especially pronounced in North America where even greater percentages losses in oil & gas pumps ranging from minus 20% to minus 50% over two years were experienced by some companies. Most affected were sales of high-pressure fracking pumps, deep subsea pumps, and artificial lift pumps of various types. Sales appear to be stabilizing with increasing probabilities for growth in the sector in 2017.

Collapsing crude oil prices and upstream CapEx had a negative impact on selected pump sales, particularly in North America and in the upstream oil & gas sector in 2015 and 2016.



Setbacks similar to upstream oil & gas were also reflected in the mining industry relative to reduced demand for coal, metals and minerals, and in a consequent reduced demand for slurry and dewatering pumps. Reduced trade in bulk commodities in-turn spilled over into the rail and marine industries in terms of reduced demand for new rail cars and ocean-going merchant vessels, and a slowdown in orders for bilge and ballast pumps, and other marine pumps.

These industry weaknesses were mirrored by the regional economic slowdowns in China and other developing countries, and by flat to low-GDP growth in several developed economies including Japan, Italy, France, and Spain.

An additional market driver occurring in 2016 was the Brexit vote by the United Kingdom to leave the European Union. While political and economic effects of this vote have not played out at this time, it is likely that the most significant effects will be felt in the financial sector, with some spill-over effects in the capital goods sector for pumps, valves, flow meters, and other industrial products, as well. Whatever effects actually occur, will be different for each country in the EU, and will be tracked on a continuous basis by Resolute Research for any needed adjustments in industrial-product forecasts.

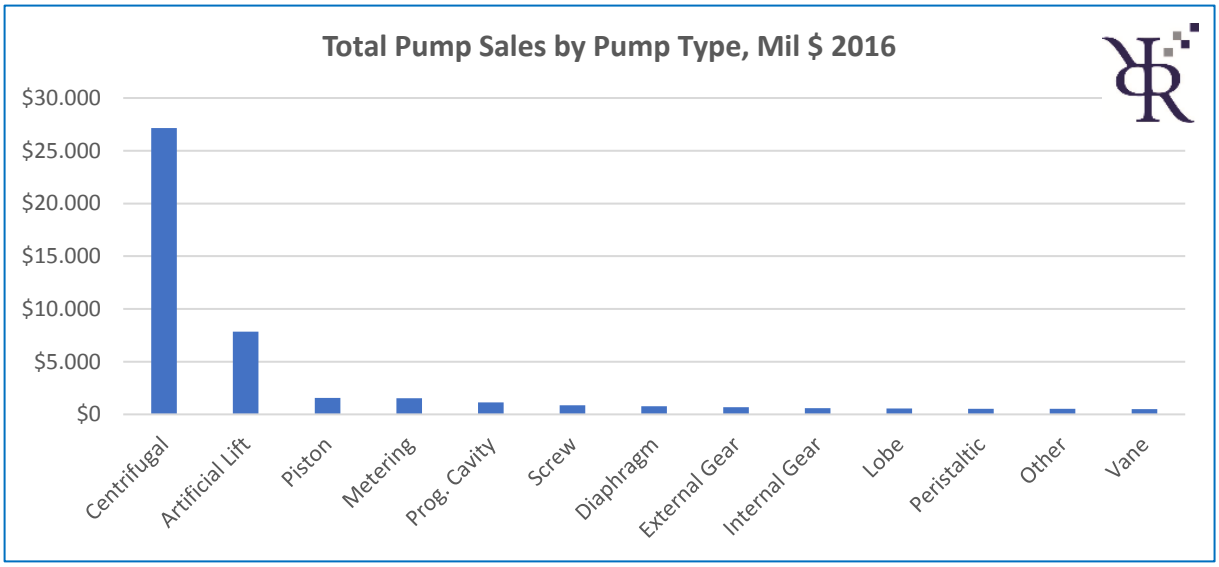
The positive note looking ahead is that the Brexit vote may have only minor effects in the long run, and that with respect to oil & gas, mining, and marine markets the regional and sector-specific setbacks can be reversed with a return to higher oil prices, and with renewed traction of traditional GDP drivers including population growth, increased urbanization, and increased standard of living in the developing economies. This is expected to begin occurring in 2017.

Acquisitions by the large multi-national companies continue to be a major activity in the industrial pump market.

The **business environment** in pumps continued to reflect rollup within the industry where major multi-national pump companies acquired smaller private companies or spin-offs from other conglomerates. In some cases, large mega-sized companies acquired or merged with other mega-sized companies.

Among the largest proposed transaction was the acquisition of Baker Hughes by Halliburton in a deal estimated at $35-billion, but with key legal hurdles from the US Justice Department and regulators in Europe was officially cancelled in 2016. A mega-merger between Schlumberger and Cameron was approved by the United States Justice Department, and became final on April 1st, 2016 with the approval of stakeholders.

Other acquisitions include: Flowserve acquisition of Netherlands-based SIHI Group; Ebara acquisition of Brazilian pump maker Thebe Bombas; Kirloskar Brothers acquisition of Netherlands pump maker Rodelta; Hillenbrand acquisition of Roper Technologies spinoff ABEL pumps of Germany; Verder Group acquisition of Germany-based Ponndorf; Watson Marlow acquisition of MasoSine from Primix; and a joint venture between Sulzer and the Saudi Pump Factory.



The **technology segmentation** of pumps continues to show that sales of centrifugal pumps dominate by a wide margin other pump technologies including vane, gear, lobe, piston, screw, progressing cavity, peristaltic, and diaphragm. Reasons for this dominance are developed later in this Report.

The **country segmentation** of pumps reflects general economic activity, and therefore supports the largest sales volume in the United States, China, Japan, Germany, France, UK, Italy, and S. Korea. However, country segmentation can exhibit significant variation for specific types of pumps. The million-dollar pressure pumps required for hydraulic fracturing, and artificial lift pumps for oil wells are disproportionately concentrated in the United States. Similarly, sales of high-pressure boiler feed pumps are currently concentrated in China and India to support the major build-out of new power plants in that Region. So, the definitive assessment of country segmentation of pumps is highly dependent on the particular type of pump.

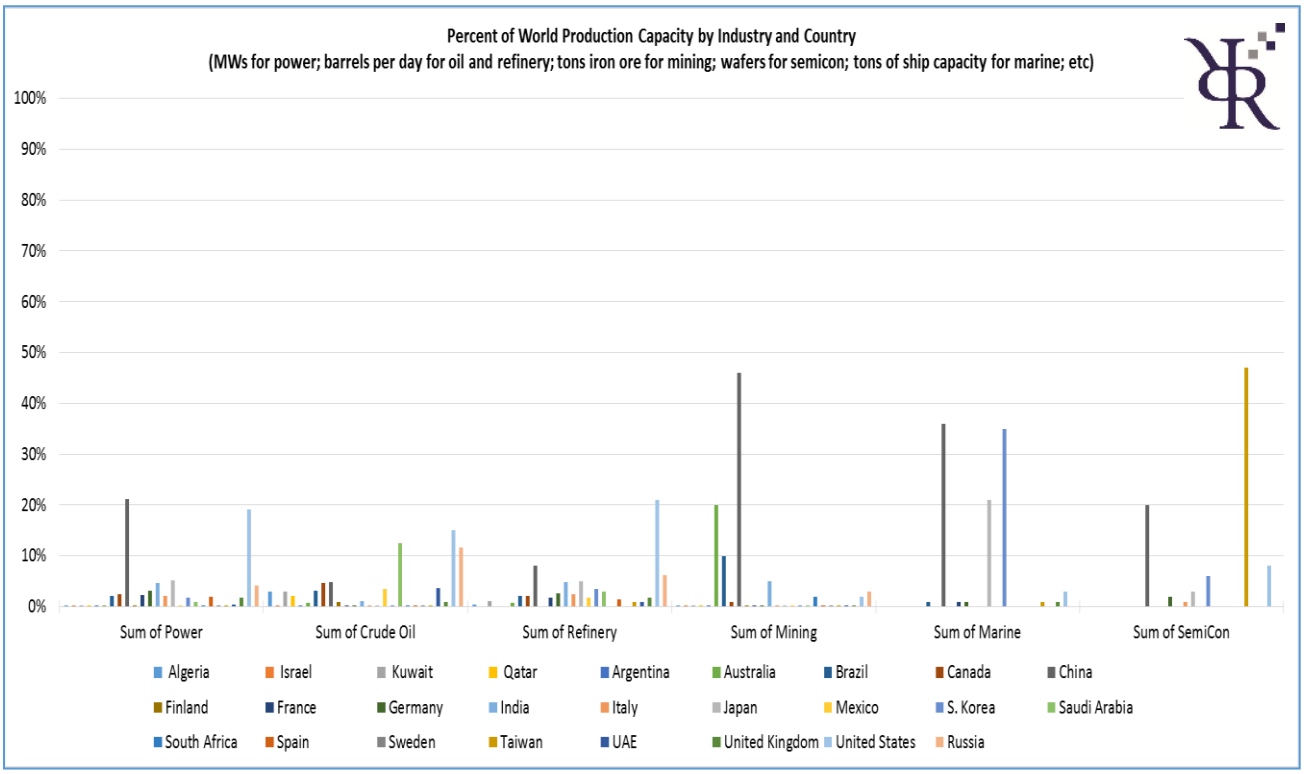
Country segmentation of pump sales is highly dependent upon pump type, as most clearly demonstrated by fracking pump and artificial lift pump sales in oil & gas.

The **industry segmentation** of pumps is skewed on an overall basis toward Oil & Gas, Water & Wastewater, Chemical/Petrochemical, and Power as the largest markets for pumps. However, there is significant segmentation of industries by country, as well. The illustration below highlights the following:

- In power, the dominance of the United States and China in terms of installed megawatts of power generation
- In upstream oil production, the significant dominance of Saudi Arabia, the United States, and Russia in terms of barrels per day production
- In refining, the significant dominance of the United States, but with growing opportunities in the Middle East and China as fuels consumption increases in developing nations
- In mining (with iron-ore production as the proxy), the significant dominance of China, Australia, and Brazil relative to the rest of the world
- In marine (merchant ships not including Navy), the near total dominance by China, Japan, and South Korea, and in semiconductor fabs, the dominance by Taiwan, South Korea, China, and Japan for basic wafer production.

Market, technological, and regional trends in pump sales are addressed at the end of this report, reflecting attractive near-term opportunities most closely aligned with basic human needs in the areas of water, electricity, food & beverages, and pharmaceuticals. These sectors are relatively insulated from the uncontrollable price fluctuations in the oil & gas, and commodities markets.

The market dynamics in the United States are being especially closely watched for possible increased opportunities in pump sales related to new pipeline construction, power plant construction, and general infrastructure spending including water & wastewater treatment plants promised by the new Administration. The situation will be closely monitored by Resolute Research.



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PUMP SUPPLIERS

There are hundreds of pump manufacturers worldwide, and the pump market is highly fragmented. However, mergers and acquisitions within the industry have resulted in substantial consolidation such that a relatively small number of suppliers now accounts for a majority of pump sales, e.g., the Top 25 Companies account for approximately 63% of all pump sales.

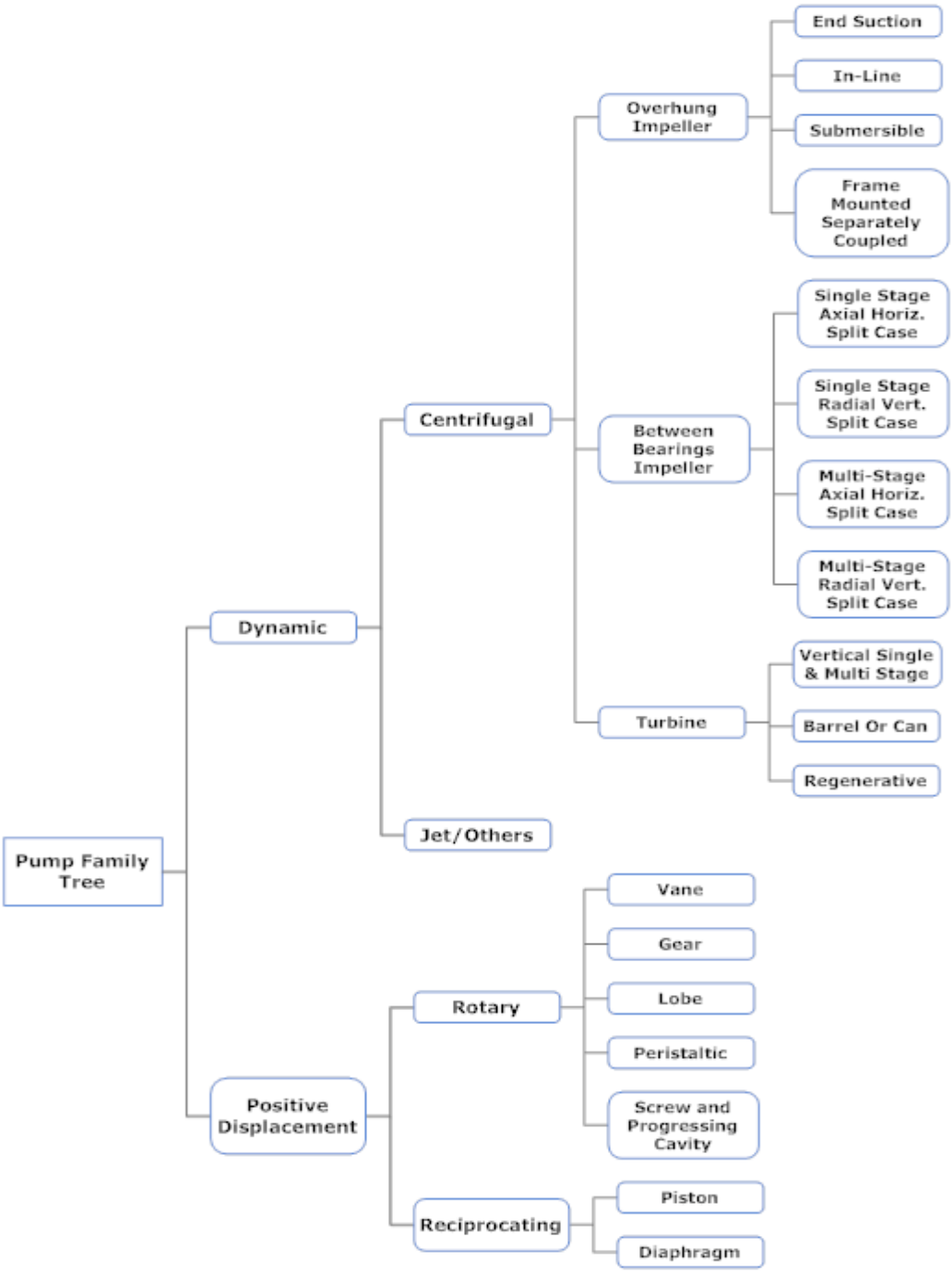
In a field of hundreds of suppliers, the Top 25 Pump Companies account for approximately 65% of total pump sales.

The company rankings listed below reflect a total market average. Actual market shares are highly dependent on market segment. In specific markets like municipal water treatment, power generation, HVAC, and others, the market shares will be significantly higher or lower for specific companies. Additionally, rankings will change year-to-year based on individual company performance, and on macro-economic events such as the 2014/2015 collapse in crude oil prices that may disproportionately affect certain companies.

Company	Ownership	Approx. Market share, %	Major Pump Brands
Grundfos	Private	8.0%	Grundfos, Alldos, Paco, Peerles
Xylem	Public	6.8%	Xylem, AC Fire Pump, Bell & Gossett, FloJet, Flygt, Godwin, Goulds, Jabsco
GE	Public	5.1%	GE, Lufkin, Quinn, SPS Pumps
Ebara	Public	4.0%	Ebara, OilSmart, Optima
Flowserve	Public	3.8%	Flowserve, Argus, Byron Jackson, CAM, Gearex, InnoMag, Jeumont-Schneider, Lawrence, Pleuger, Pacific, Niigata, Sier Bath, Sihi, TKL, Worthington
Sulzer	Public	3.4%	Sulzer
KSB	Public	3.4%	KSB, Amajet, Amacan, Amarox, EcoChem, Eta Prime, Movitec, Magnochem, RioTherm, Sewatec, Vitachrom, Vitalobe
Schlumberger	Public	3.1%	Schlumberger, Kudu, Reda
Dover	Public	2.7%	Abaque, Almatec, Blackmer, Envirogear, Finder, Griswold, maag, Mouvex, Neptune, PSG, Quattroflow, Redscrew, System One, Wilden
Weatherford	Public	2.5%	Weatherford, AmpScot, Ellis-Williams, RotaFlex
Wilo	Private	2.1%	Wilo, Stratos, Pico
Baker Hughes	Public	1.9%	Gorilla, Rhino
Alfa Laval	Public	1.8%	Alfa Laval, Framo, LKH, Oliver M Dean, OptiLobe, SRU
Weir	Public	1.8%	Weir, Begemann, Envirotech, Floway, Gabbioneta, GEHO, Hazleton, Hidrostal, HydraFlo, Lewis, MultiFlo, Warman, Wemco, Weir SPM
ITT	Public	1.7%	ITT, AC Pump, Bornemann, Goulds
Pentair	Public	1.7%	Pentair, Aurora, Berkeley, Delta, Edwards, Fairbanks-Nijhuis, Hydromatic Hypro, Jung Pumpen,Layne, Sta-Rite, ShurPro
Putzmeister	Private	1.6%	Sany, Putzmeister
IDEX	Public	1.3%	IDEX, Blagdon, Corken, Godiva, Hale, Knight, MicroPump, OBL, Pulsafeeder, Periflow, Richter Chemie, SAMPI, Trebor, Viking Pumps, Vican Pumps, Versa-Matic, Warren Rupp, Wright Pump
Franklin Electric	Public	1.3%	Franklin Electric, Little Giant, Pluga Pumps, IMPO, Pioneer Pump
Nikkiso	Public	1.2%	Geveke, Lewa, Nikkiso
SPX	Public	0.9%	SPXFlow, Bran+Luebbe, Clyde Union, Johnson Pump, Plenty, Waukesha Cherry Burrell
Bosch Rexroth	Public	0.8%	Bosch Rexroth
Kirloskar	Public	0.8%	Kirloskar, SPP Pumps, Rodelta, Braybar
Colfax	Private	0.8%	Allweiler, Imo, Houttuin, Warren, Rosscor, Tuschaco, Zenith
Torishima Pump	Public	0.8%	Torishima

PUMP TYPES

Pumps can be broadly classified as **dynamic** or **positive displacement.** *Dynamic* pumps impart kinetic energy to the fluid to provide fluid pressure and movement and include the large family of **centrifugal pumps** and several other types. *Positive displacement* pumps sequentially entrap, displace, and expel specific volumes of fluid to provide fluid movement, and include **gear, lobe, vane, piston, peristaltic, screw, progressing cavity, and diaphragm pumps.** As noted in the illustration, centrifugal pumps are available in a large family of configurations that supports wide application throughout many industries.



PUMP APPLICATION BY PUMP TYPE

Centrifugal Pumps: Centrifugal pumps are available in many different designs including single-stage and multi-stage, end suction, in-line suction, horizontal split case, vertical split case, vertical turbine, submersible, and many others. They are widely scalable in terms of pressure and flow from very low flow and pressure, up to thousands of psi and 100,000 gpm or more. Centrifugal pumps can handle clean or dirty liquids, and slurries with the right selection of impeller. Centrifugal pumps are best with low viscosity liquids not containing air or vapors, and are generally not used with shear sensitive liquids, especially at high rotational speeds. Taking all factors into account, centrifugal pumps are the most commonly used pump with applications in power, refinery, petrochemical, chemical, water treatment, mining, pulp & paper, and general industry.

Gear Pumps: Gear pumps include rotating intermeshing gears and are available in internal and external gear types. Gear pumps are not well suited to handle solids or abrasive liquids, and are generally best applied on clear, clean liquids such as oil or fuel. Internal gear pumps are well suited for high viscosity liquids with minimal inlet pressure. They are also ideal with low viscosity products like propane or ammonia. External gear pumps are well suited for high pressure applications with clean liquids, such as in hydraulics systems.

Lobe Pumps: Lobe pumps have two intermeshing lobes. The lobes do not touch because of synchronized rotation controlled by timing gears. The “no metal-to-metal contact” allows gentle pumping action that is ideal for liquids containing soft or fragile solids, or viscous liquids, or shear sensitive liquids. These pumps are available in sanitary clean-in-place (CIP) designs for food, pharmaceutical, and biotech applications, and are generally the pump of choice for sanitary applications involving viscous liquids or liquids with fragile solids. The pumps have low suction ability and are not well suited for low viscosity liquids.

Vane Pumps: Vane pumps include a rotor with movable vanes operating within an eccentrically shaped casing. As the rotor turns, the vanes slide in and out of the slots to maintain contact with the casing. Vane pumps are well suited for oils and higher viscosity liquids, and are often an alternative for gear pumps. They are also suitable for thinner, clean liquids with no solids, like gasoline or other fuels. Vane pumps are often found on fuel transport vehicles, and at loading and unloading terminals that handle many types and grades of fuels.

Piston and Plunger Pumps: Piston pumps are reciprocating pumps that include double acting pistons. They are widely used with water and other thin liquids that may contain abrasives. Plunger Pumps are also of a reciprocating design, but typically include three or five single acting reciprocating plungers (triplex and quintuplex pumps). Piston and plunger pumps are used in oil production, pressure washing, car washes, reverse osmosis, and other applications where high pressure is required. These pumps can develop pressures from 15,000 to 60,000 psi, or higher depending on design.

Peristaltic Pumps (Hose Pumps): Peristaltic pumps, sometimes called "hose pumps" include a rotating element that squeezes a flexible tube or hose as it rotates. The squeezing provides a pumping action that moves the liquid along the tube. The pump requires no seal, and therefore offers zero leakage pumping. The pumps generally include replaceable hoses that are selected for compatibility with the liquid being pumped. Peristaltic pumps are used to handle corrosive or hazardous chemicals (including liquids with entrained solids) in wineries, sewage treatment plants, and in many applications requiring sealless zero-leakage pumping. The pumps are usually limited to flows below 250 gpm.

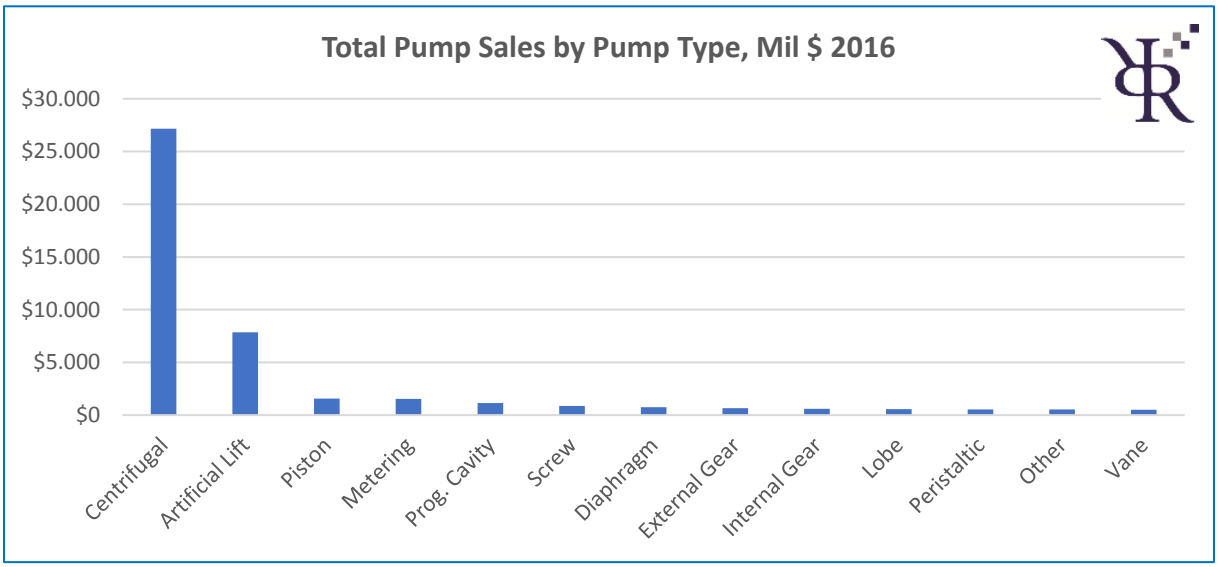
Screw and Progressing Cavity Pumps: Screw pumps are available in two and three screw designs. They are commonly used for oils, fuels, and other viscous liquids. Common applications include fuel transfer, hydraulics, and other applications requiring relatively high flow rates of viscous liquids. Screw pumps are also suitable for use with multi-phase liquids. 3-screw pumps are widely used for lubrication of rotating machinery. Progressing cavity pumps include a single-threaded helically shaped rotor that creates a progressing cavity within the pump that moves and pressurizes the liquid from pump inlet to pump outlet. These pumps provide gentle pumping action on shear sensitive liquids such as polymers used in water treatment, and in other industrial plants including pulp & paper mills, and petrochemical and chemical plants. Progressing cavity pumps are also used in artificial lift applications in upstream oil and gas.

Diaphragm Pumps: Air Operated Double Diaphragm (AODD) pumps are diaphragm-type pumps driven by air rather than an electric motor. They are used in applications in general industry where electricity is not available or where electricity is not advisable due to dangerous explosive conditions. The pumps are also widely used in applications involving liquids with large entrained solids, or high-viscosity liquids, such as food & beverage, and in mine dewatering.

PUMP SALES BY PUMP TYPE

Centrifugal pumps are used in many applications, but are best suited for low viscosity and thin liquids, such as water or water

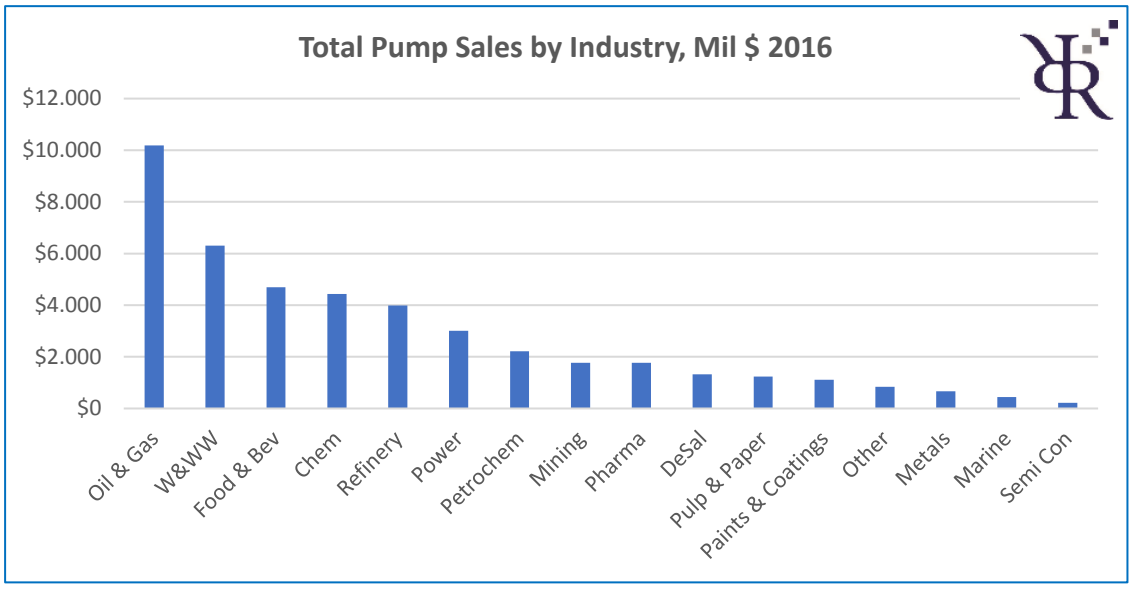
Centrifugal pumps are the most widely used pump because they are the best technology for water and thin liquids and slurries that are encountered in nearly every industry. Additionally, centrifugal pumps are highly scalable and can be applied in small sizes for low-flow applications such as circulator pumps for HVAC heating systems at 10 to 15 gpm, as well as in scaled-up sizes for high flow applications over 100,000 gpm, such as in power plant condenser cooling. Centrifugal pumps are also highly scalable in terms of pressure, and with multistage designs can deliver pressures to thousands of psi, such as required for feed water pumps supplying steam boilers in power plants or seawater to reverse osmosis membrane filtration systems. Centrifugal pump applications, however, may be limited by high viscosity liquids, sheer sensitive liquids, liquids with large or fragile solids, and liquids with large volumes of entrained air or gas. These additional application requirements provide opportunities for the **positive displacement pump** technologies shown in the illustration below.



The **positive displacement** family of pumps including vane, gear, lobe, piston, screw, progressing cavity, peristaltic, and diaphragm have evolved over time to address the applications where centrifugal pumps either cannot be used or cannot perform efficiently. As such, these other pumps are specialty pumps with fewer applications and fewer suppliers than centrifugal pumps. These pumps will usually be found in applications with high-viscosity liquids (screw or diaphragm pumps), sheer sensitive liquids (lobe or pc pumps), liquids with large fragile solids (lobe or diaphragm pumps), multi-phase liquids (progressing cavity or screw pumps), pipeline liquids like oil (piston pumps, screw pumps, gear pumps), or sanitary applications (lobe, diaphragm or peristaltic pumps).

PUMP SALES BY INDUSTRY

Although pumps are found in virtually every industry, oil & gas, water & wastewater, food & beverage, chemical, refinery, and power are among the largest applications as a result of being liquid intensive industries and generally dealing in fundamental human consumables including water, food, and energy.



The **oil & gas, chemical/petrochemical, semiconductor, and pharmaceutical industries** are in many cases intolerant of product leakage or contamination and use significant numbers of diaphragm pumps, canned-motor pumps, and seal-less mag-drive centrifugal pumps. Upstream oil & gas uses large numbers of pumps for artificial lift including sucker rod pumps (SRP), plunger lift pumps, electric submersible pumps (ESP), progressing cavity pumps (PCP), and gas lift. The artificial lift pump market is estimated at more than $10-billion per year, although with recent setbacks in 2015. Downstream oil & gas (refinery) uses many centrifugal pumps, but also screw pumps for higher viscosity applications including pipeline startup, tank stripping, and distiller bottoms pumping.

The **food & beverage** industry is intolerant of contamination, and frequently involves high viscosity liquids such as custards or pie fillings, and liquids with large fragile solids, such as whole cherries or olives, among many others. Clean-in-place (CIP) sanitary diaphragm pumps, lobe pumps, peristaltic pumps, and progressing cavity (pc) pumps are widely used.

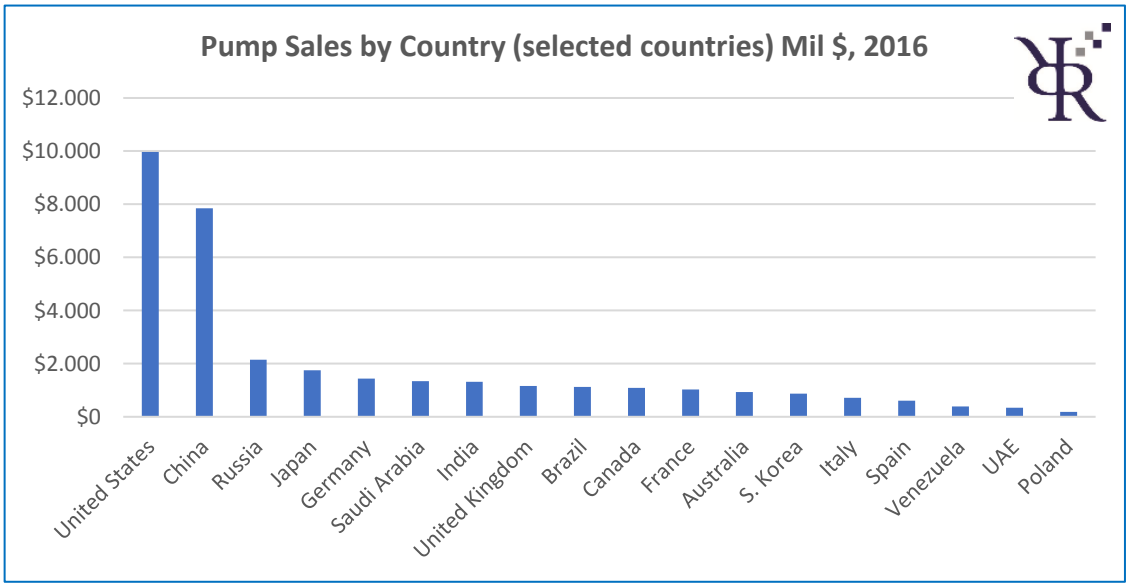
The **power, water, waste water, oil & gas, and the pulp & paper** industries use significant amounts of water treatment chemicals, and chemical metering pumps are used in substantial numbers. Market for chemical metering pumps is approximately $1.7-billion/year.

PUMP SALES BY REGION

At a high level, the geographic distribution of pumps reflects general economic activity, although the rapid growth in some countries, particularly China and India make purchases of pumps greater than would be expected merely by GDP. Put another way, new pump sales are at a higher level in developing countries because of infrastructure expansion, whereas in developed countries in North America and western Europe low organic growth is limiting pump sales largely to replacements and aftermarket parts.

Significantly, the geographic segmentation of pump sales may reflect anomalies related to concentration of a particular industry in a particular region. For example, there has been a disproportionate level of activity in high pressure piston pumps in North America reflective of hydraulic fracturing for shale gas. Similarly, there is a concentration of ultra-pure engineered-plastic chemical pumps in Asia reflective of the high concentration of semiconductor foundries in Asia that require specialized pumps for semiconductor production. So, it is critically important to consider pump type in any geographic segmentation study.

The graph below shows the segmentation of all pump types (collectively) by major country. As shown, the United States and China dominate world markets on a country-by-country basis. The United States is skewed higher by the large value of artificial lift pumps employed in the oil & gas industry, and that is not repeated in any other country to the same degree. Country rankings subject to change year-over-year because of major industry movements (like oil & gas) and the close revenue-positioning of many of the countries listed in the illustration.



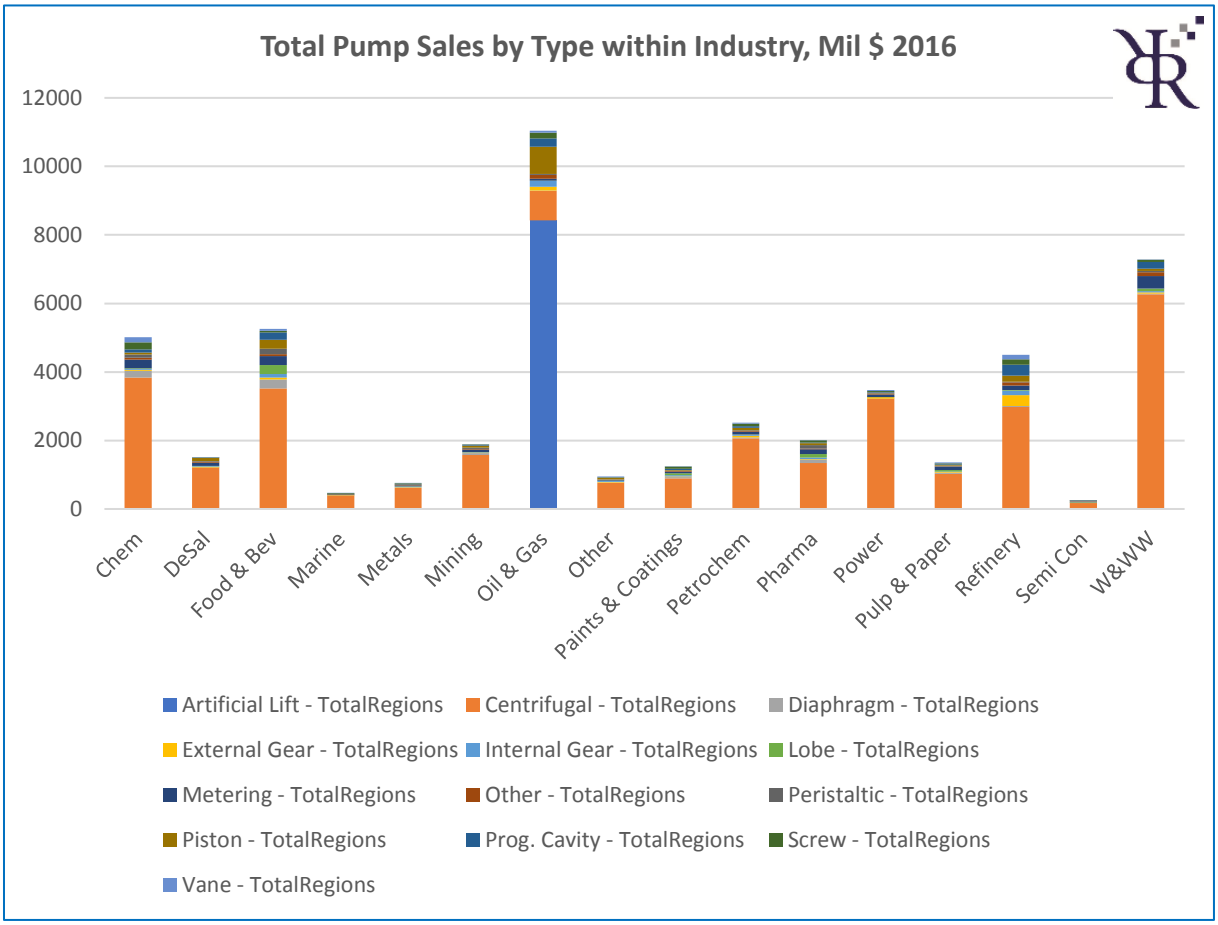
PUMP SALES BY INDUSTRY & PUMP TYPE

Distribution of pump sales by pump type and industry is characterized by several significant attributes.

The first attribute is the dominance of centrifugal pumps across all industries, except upstream oil & gas where artificial lift pumps (some of which are centrifugal) are the dominant pumping technology.

A second significant attribute is the concentration of certain pump technologies (besides centrifugal) in specific industries. For example, there is a higher concentration of lobe pumps in sanitary industries, and metering pumps in water treatment industries. These trends are difficult to discern in standard charts because of the overwhelming dominance of centrifugal pumps, but become more apparent in an analysis where centrifugal pumps and artificial lift pumps are segmented out of the analysis. This type of selective analysis is possible with the Pump Product Data Base which is available through Resolute Research.

The illustration below highlights basic segmentations of pump types by industry. The dominance of centrifugal pumps is evident.



PUMP SALES BY NEW VS. AFTERMARKT

Calculation of new sales vs. aftermarket sales is a multi-variable operation that involves market growth rate, size of the installed base, product life expectancy, and other factors.

In addition to new vs. aftermarket sales, pump revenues reflect spare and replacement parts which are generally about 40% of total pump sales for most pump companies. Therefore, actual complete pump sales are about 60% of revenues published in most market studies.

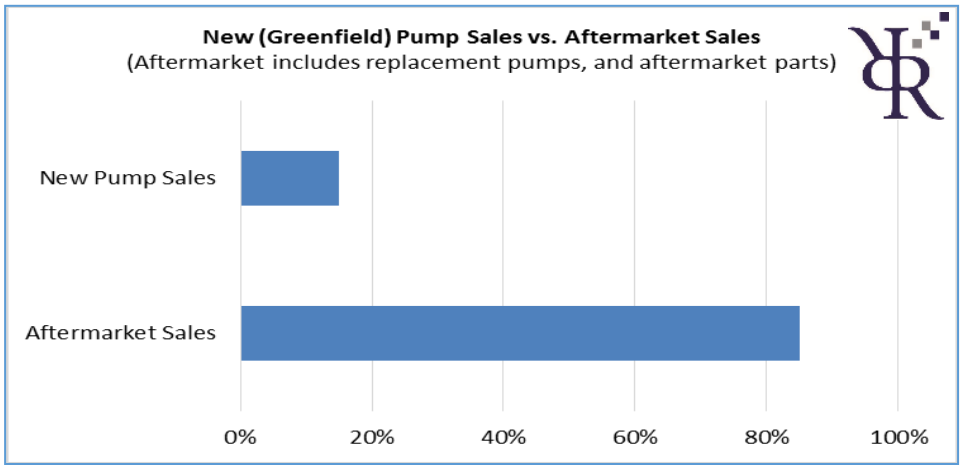
The distribution of pump sales by *new sales vs. aftermarket sales* is an important consideration in go-to-market strategy. It is a topic with multiple factors including the growth rate of the basic market, the size of the installed base, the average life-expectancy of the product, and the geographic region in question.

This last point is best illustrated by consideration of a real-world scenario. The installed base of coal-fired power plants in the United States is large, yet no new coal-fired power plants have been built for a significant time because of environmental and legislative issues. Therefore, the coal-fired power plant pump market in the US is virtually 100% aftermarket (parts and replacement pumps). Conversely, the coal-fired power plant build rate in China is high, and most existing plants are less than 20 years old. In that region, pump sales are largely new (greenfield) sales. So, the market conditions of the region are important in assessing new vs. aftermarket sales.

That notwithstanding, new vs. aftermarket sales are fundamentally a function of the growth rate of the market, the size of the installed base, and the life expectancy of the product. In this context, a straight forward assessment can be made, with the other considerations required only to fine-tune the analysis.

- Assume an installed base of 100 units
- Next assume an approximate 20-year life expectancy for the product
  - This suggests an annual replacement factor of 1/20 or 0.05
  - It can then be calculated that the annual aftermarket sales are equal to the installed base (100 units) times 0.05 or 5 units/year
- The new-product sales can be inferred by taking total sales in the Region, less the computed aftermarket sales.

As a general rule for ***mature*** markets, new pump sales vs. aftermarket pump and parts sales is broadly characterized as shown in the illustration below. As noted earlier, the situation is markedly different for an emerging market, such as Asia.



PUMP APPLICATION GUIDELINES

Centrifugal pumps are applied in many applications. However, some applications are best suited for alternative types of pumps, and this has given rise to the positive displacement family of pumps including gear, vane, lobe, piston, peristaltic, diaphragm, progressing cavity, screw, and others. The following tables provide general (not absolute) guidelines for pump applications.

Fluids and Fluid Characteristics	**Pump Type**							
	Centrifugal	Vane	Gear	Lobe	Plunger/ Piston	Screw /**PC**	Peristaltic	AODD Diaphragm
Water	Prime Application	Suitable	Gen. Not Used	Gen. Not Used	Suitable	Gen. Not Used	Suitable	Suitable
Abrasive Slurries	Prime Application	Not Suitable	Not Suitable	Suitable	Prime Application	Prime Application	Suitable	Prime Application
Hazardous Chemicals	Suitable (MagDrive)	Gen. Not Used	Suitable	Gen. Not Used	Suitable	Suitable	Prime Application	Prime Application
Light Fuels	Suitable (MagDrive)	Prime Application	Suitable	Gen. Not Used	Gen. Not Used	Suitable	Gen. Not Used	Gen. Not Used
Heavy Fuels & Oils	Gen. Not Used	Prime Application	Prime Application	Gen. Not Used	Gen. Not Used	Prime App Screw	Gen. Not Used	Gen. Not Used
High Viscosity with solids	Gen. Not Used	Not Suitable	Not Suitable	Prime Application	Gen. Not Used	Prime App. PC	Prime Application	Prime Application
Sanitary	Gen. Not Used	Not Suitable	Not Suitable	Prime Application	Gen. Not Used	Suitable (PC)	Prime Application	Prime Application
Low to Mod. Flow (< 500 gpm)	Prime Application	Prime Application	Prime Application	Prime Application	Prime Application	Prime Application	Prime Application	Prime Application
High Flow (1,000 gpm to 5,000 gpm)	Prime Application	Suitable	Suitable	Suitable	Suitable (Plunger)	Suitable	Not Applicable	Not Applicable
Ultra-High Flow (> 10,000 gpm)	Prime Application	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Suitable (Screw)	Not Applicable	Not Applicable
High Press (1,000 psi to 5,000 psi)	Suitable MultiStage	Not Applicable	Prime Application	Not Applicable	Prime Application	Prime Application	Not Applicable	Not Applicable
Ultra-High Pressure (> 10,000 psi)	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Prime Application	Not Applicable	Not Applicable	Not Applicable
Sheer Sensitive Liquids	Gen. Not Used	Not Suitable	Not Suitable	Prime Application	Prime Application	Prime Application	Prime Application	Prime Application

Positive Displacement, Gear, Lobe and Vane Pump Performance Guidelines

Pump Type	**Abrasive Liquids**	**Thin Liquids**	**Viscous Liquids**	**Liquids + Solids**
Internal Gear	Average	Good	Excellent	Poor
External Gear	Poor	Good	Good	Poor
Lobe	Good	Average	Excellent	Excelent
Vane	Poor	Excellent	Average	Poor

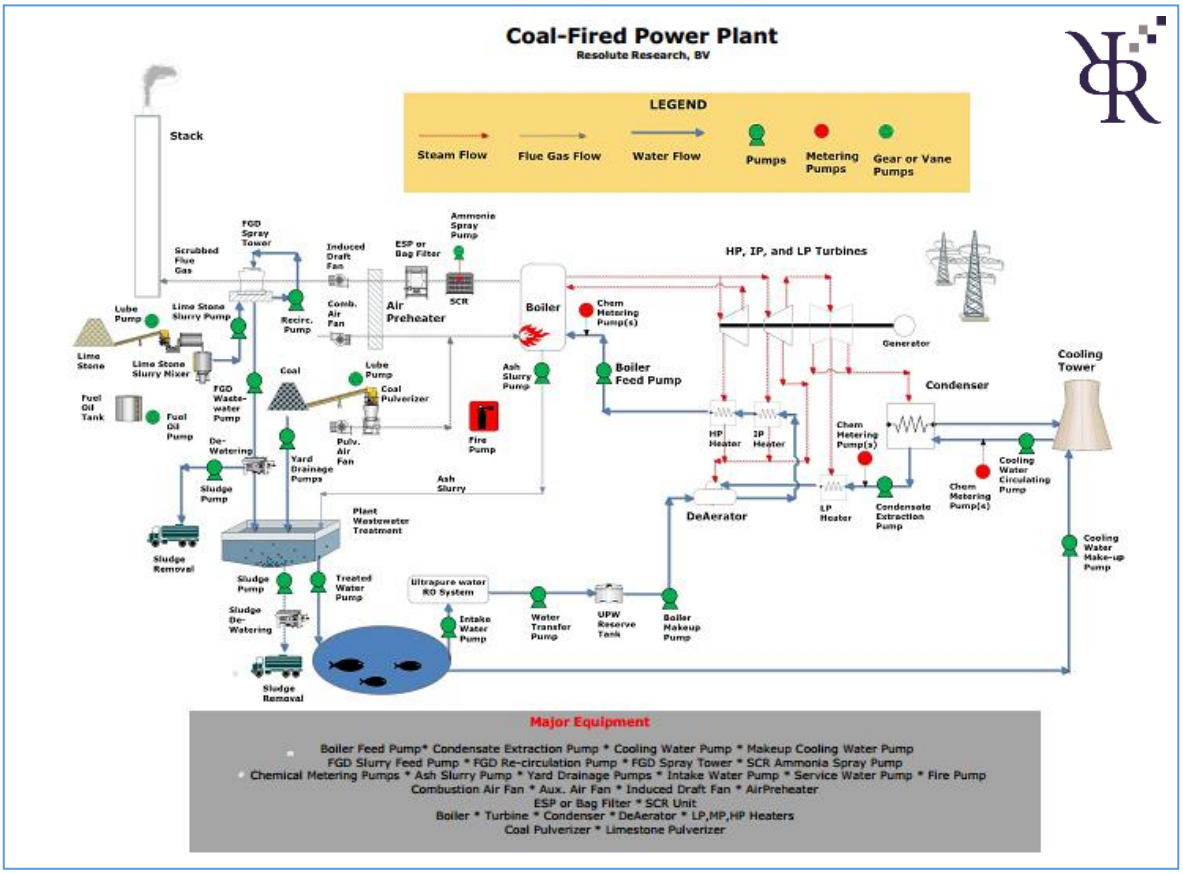
Positive Displacement, Progressive Cavity, and Screw Pump Performance Guidelines

Pump Type	**Abrasive Liquids**	**Various Liquids**	**Sheer-Sensitive Liquids**	**Liquids + Solids**
Prog. Cavity	Excellent	Good	Excellent	Excellent up to 3.5”
2 screw	Good	Excellent	Good	Good up to 1/32”
3 screw	Good	Good	Good	Clear

NOTES: Many 3-screw pumps are used for lube oil supply on engines, turbines, compressors or as pipeline booster pumps for low viscosity oil. 2-screw pumps are used for crude oil, pipeline startup pumps, or produced-water pumps. They are well suited for contaminated, non-lubricating and high viscosity liquids. Special designs of screw and PC pumps are used for multiphase pumps (MPP).

PUMP SELECTION BY PROCESS FLOW REQUIREMENT

Pumps are often applied in similar ways within specific industries. For example, pumps in coal-fired power plants (illustration below) are supplied to meet basic system functions including water intake, boiler feed, condensate extraction, cooling water circulation, flue gas scrubbing, chemical metering, and many other basic pump functions. Pumps in these applications at different power plants will usually be subjected to similar process requirements relative to flowrate, pressure, and temperature because new coal-fired plants are mostly constructed to the 1,000-MW supercritical design model. This has led to similarities in the “spec envelope” for pumps in these applications, and to a certain degree of standardization in plant design.



The process flow diagram for any other industry, including refinery, wastewater treatment, seawater desalination, metals processing or any other is a useful tool for analyzing not only specific pump technical requirements, but also for estimating market size, market growth, and market trends for pumps.

PUMP OPPORTUNITIES BY INDUSTRY

Pump opportunities vary by industry, region, and pump type depending on specific market dynamics.

For example, worldwide market dynamics have temporarily depressed growth in major industries including oil & gas, marine, pulp & paper, and metals and mining. The driving dynamic could be a collapse in prices such as in the oil and metals commodities markets, oversupply of capacity such as in the marine market, or reduction in end-use demand such as in the print media market.

In other cases, the market dynamics may be more regional, such as in power generation, which has seen very little load growth in Organization for Economic Cooperation and Development (OECD) countries in North America and western Europe, while there has been major load growth in developing economies such as China and India.

In addition to these dynamics, pump opportunities are also reflective of pump technology. The table below provides a snapshot of opportunities based on industry, region, and technology considerations. All projections reflect near-term circumstances and are subject to change over time.

Industry sector	Regional Opportunity		Pump Technology Opportunities	Comments and Market Drivers
	OECD Countries	Developing Countries		
Water & Watewater	Favorable	Favorable	centrifugal; chemical metering; progressing cavity for sludge.	Infrastructure rebuild in OECD; New builds and standard of living improvements in developing countries.
Food & Bev	Favorable	Favorable	sanitary pumps including diaphragm; peristaltic; lobe.	General population growth; improvement in standard of living for underdeveloped regions.
Pharma	Favorable	Favorable	sanitary pumps including diaphragm; peristaltic; lobe.	General population growth; improvement in standard of living for underdeveloped regions.
Power	Neutral	Favorable	Centrifugal for high pressure boiler feed; chemical metering.	Low load growth and focus on renewables in OECD; load growth in developing regions, and including coal, gas, and nuclear power plants.
Oil & Gas	Neutral	Favorable	artificial lift; piston for well fracking, acidizing, cementing; chemical metering.	High production costs for unconventional resources in OECD; low production costs in developing regions and the Middle East.
Refinery	Neutral	Favorable	centrifugal; progressing cavity; screw; vane; gear.	Low consumption growth in OECD; consumption growth and industry expansion in developing regions.
Metals & Mining	Unfavorable	Neutral	-	High extraction costs in OECD; low extraction costs and new resources in developing regions.
Pulp & Paper	Unfavorable	Neutral	-	Lower demand for print media due to digital era; low cost production in developing regions, with opportunities in corrugated board and packaging.
SemiCon Fabs	Unfavorable	Favorable	diaphragm; peristaltic; engineered plastic pumps.	Low manufacturing capacity in OECD; growth of production capacity and consumption in developing regions.
Marine	Unfavorable	Neutral	centrifugal; slurry pumps for flue gas desulfurization (FGD).	Low manufacturing capacity in OECD; working off current over capacity worldwide; aftermarket opportunities for ballast water treatment and flue gas treatment driven by international environmental legislation.

PUMP MATERIALS OF CONSTRUCTION

The materials of construction for pumps generally reflect broad industry practices, and are different for different pump parts including housings, impellers, shafts, seals, and bearings. Nevertheless, some broad guidelines generally apply. For example, the food & beverage and pharmaceutical industries are large users of stainless steel pumps (also oil refineries for resistance to sulfur corrosion, and desalination plants for resistance to seawater); the semiconductor industry is a large user of engineered-plastic or polymer-lined pumps that meet ultra-pure standards and can deal with aggressive chemicals; and the marine industry is a large user of bronze or Super Duplex stainless steel pumps. In the Oil & Gas segment, standards such as API-610 may define the recommended materials of construction. In all cases, materials of construction must be carefully matched to the specific application, including consideration of process parameters like pressure, temperature, concentration (particularly for acids), abrasion, potential for stress crack corrosion, and other factors. For abrasive slurry applications, rubber lined or case-hardened materials may be used, particularly for pump volutes.

The following table provides general guidelines on pump wetted materials of construction relative to some common liquids. Depending on the application, other materials may be suitable, as well.

Liquid Class	Liquid	Frequently used materials of construction
Waters	Fresh water	Brass, Bronze, 316 Stainless Steel
	Seawater	Bronze, 316 Stainless Steel, Duplex Stainless Steel, Alloy 20
Slurries	Lime slurry	Cast iron, Cast steel
Refined Fuels	Gasoline, Kerosene, Diesel	Carbon steel, 304 and 316 Stainless Steel, Alloy 20
Fuel Oil	Various	316 Stainless Steel
Vegatable Oils	Various	316 Stainless Steel, Alloy 20
Acids	Citric Acid	316 Stainless Steel, Alloy 20, Alloy B
	Hydrochloric Acid	Alloy B
	Sulfuric Acid	Alloy 20
	Nitric Acid	316 Stainless Steel, Alloy 20
Fruit Juices	Various	316 Stainless Steel, Alloy 20, Alloy B
Alcoholic Beverages	Beer	316 Stainless Steel, Alloy 20
	Whiskey & Wines	316 Stainless Steel, Alloy 20

PUMP INDUSTRY STANDARDS

Most industries require that pumps meet specific industry standards. American National Standards Institute (ANSI) defines **critical dimensions** such as flange to flange compatibility for pumps regardless of manufacturer. Chemical process pumps and many others are often governed by the American National Standards Institute. Pumps conforming to these dimensional standards are called “ANSI pumps”. In the Oil & Gas industry, American Petroleum Institute (API) Standards 610, 614, 674, 675, and 676 often apply and define specific ***quality standards***. API pumps are more robust than ANSI pumps and are sometimes specified outside of oil and gas in critical safety applications, such as in high temperature and pressure applications in power generation. However, since API pumps may cost 5 or more times the price of an ANSI pump, specification of API pumps outside of required applications is done only where necessary.

North American Standards

Fire pumps in the United States must meet National Fire Protection Association (NFPA) 20 requirements. Sanitary food & beverage industry pumps are governed by Food & Drug Administration (FDA) standards in the US.

European Standards

Pump sales in Europe are also governed by standards and organizations dedicated to ensuring pump performance and quality. In Europe, pump manufacturers often become voluntary members of a national association, such as VDMA in Germany, BPMA in the UK, DK Pumps for Danish pump companies, and others depending on the country. These national associations may in turn become voluntary members of EUROPUMP which is multi-national in scope. In addition to national associations, there are *national standards bodies* such as BSI in the UK, DIN in Germany, SNV in Switzerland, or AFNOR in France. Food & beverage sanitary applications are governed by the European Hygienic and Engineering Design Guidelines (EHEDG).

The CEN (European Committee for Standardization) is an organization that supports harmonization of European standards described above. Membership in CEN is generally restricted to members of the European Union. Harmonized Pump Standards are published in CEN/TC 197.

World Standards

ISO provides a *worldwide* structure that supports defined quality and performance standards for pumps on a worldwide basis. The section of ISO that relates directly to pumps is TC 115. Compliance to all applicable pump standards (industry, national, and global) is essential for multi-national pump companies to be successful and is consequently handled by dedicated specialists knowledgeable in the field within each company.

PUMP SUPPLIERS BY PUMP TYPE

Listings of suppliers segmented by pump type are provided below. These segmented lists are not all-inclusive, but reflect significant suppliers.

Positive Displacement Pumps

Gear Pumps: Albany Pump, Brown & Sharpe, Bosch Rexroth, Calpeda, Colfax (Imo, Allweiler, Tushaco), Coreau, Cucchi Pompe, Daikin, Del Pumps, Delta Pumps, Dover (Esbray), ECO, Eaton, Flowserve, Gita, Graco, Gorman Rupp, GVR Pompe, Houston Hydraulics, Haight Pumps, Hayward Tyler, Hespar, HG Machinery, Honor Gear Pump, IDEX (MicroPump, Pulsafeeder, Vican, Viking), JEC, Kraissl, KYB, McNally Industries, Oberdorfer, Oilgear, Parker, Picut Industries (Liquiflo), Piusi, Pump Engineering, Quality Control Corp, Roper, Rotan, Ruthman, SAWA, Settima, Scherzinger, Shanghai Huanggong, SKF, Seemsan, Sigma Hranice, SPXFlow (Johnson Pump, Plenty Mirrlees), Swedenborg, Tianjin, Tuthill, Verder, Vogelsang, Witte, Yildiz, Zeifelder, others

Lobe Pumps: Alfa Laval (LKH, OptiLobe), Boerger, Fristam, Grundfos, Holland, IDEX (Viking Pump), JEC, Lobeflo, Muniflo, Netzsch, SPXFlow (Johnson Pump, Waukesha Cherry-Burrell), Tuthill, Vogelsang, Xylem (Jabsco), others

Vane Pumps: Caster, Colfax (Imo, Allweiler, Tushaco), Dover (Blackmer, Mouvex), IDEX (Corken, SAMPI, Viking), Leistritz, Netzsch, Piusi, Roper, Seemsan, SPXFlow (Johnson Pump, Mirrlees), Shanghai Huanggong, Tuthill, others

Progressive Cavity and Screw Pumps: Andritz, Baker Hughes, Chongqing, Colfax (Imo, Houttuin, Warren, Allweiler, Tushaco), Dover (Redscrew), Flowserve, Flowrox, GE (Lufkin, Quinn), Jessberger, Hangzhou Xinglong, ITT (Bornemann), Jiangxi,Xinde, Kral, Kachele, Kudu, Knoll, Leistritz, Mono, Robbins Myers (Moyno), Nanjing Industrial Pumps, Netzsch, PCM Pumps, Protex, Roper, Rotomac, seepex, Seemsan, Shanghai Huanggong, Shanghai Aote, Settim, Sydex, SPXFlow, Sulzer, Tianjin Huaonan, Tarby, Verder, Weatherford, others

Peristaltic Pumps (Hose Pumps): Abaque, Barnant, Blue-White, Boyser, Elro, Enertech, Flowrox, Flexicon, Graco, IDEX (PulsaFeeder, Periflo), PCM Delasco, Masterflex, Millipore, Ragazzini, Solinst, SPXFlow, Spirax-Sarco (Bredel, Watson Marlow), Stenner, Thermo-Scientific, Vanton, Verder, Vereflex, Waukesha, others

Diaphragm Pumps–AODD: Ingersoll Rand (ARO), Adris, SPX (Clyde Union), Crane (Depa), Dayton, Debem, Delatec Enterprises, Flotronic, Flux, Graymills, Graco, IDEX (Warren Rupp, Versamatic, Blagdon), Jessberger, Lutz, Murzan, Price, Serfilco, SPX (Johnson Pump, Novaflex), Dover (Wilden), Tapflo, Verder, Wenzhou, Yamada, others.

Hydraulic Diaphragm Pumps (process pumps): Kimray, Aker-Wirth, Yamada, Peroni, Uraca, Wanner Engineering, others

Pressure Pumps (Piston Pumps): Axon, Aker Wirth, B&G, Bethlehem, Cameron (Lewco, LeTourneau), CAT Pumps, SPX (Clyde Union), Dyna, Dynex, Dragon Products, Finder, Flowserve, FMC Technologies, Frac Tech, Gardner Denver, Halliburton, Hammelmann, Hebei Hengsheng, Hero-Nisha, Wanner Engineering (Hydra-Cell), Lewa, McFarland/Triton, NLB, National Oil Well Varco (NOV), Procint, Pro-Source, Rodelta, SPXFlow, Uraca, Weatherford, Weir, Wepuko, White Star, others

Centrifugal Pumps

Aggressive Media Mag Drive and Polymer Lined Centrifugal Pumps: Andritz, ASV Stubbe, Bungartz, ChemPump, CDR Pump, CP Pumpen, Duchting, Ebara, Finish Thompson, Flowserve, Friatec, Griswold, Guanxing, Hazelton, KSB, Lawrence, Lederle Hermetic, IDEX (Richter Chemie), Innomag, ITT (Goulds), Lutz Jesco, March Pumps, Munsch, Price Pump, Ruhrpumpen, Savino Barbera, Schmitt, Serfilco, Someflu, SPXFlow (Johnson Pump), Sulzer, Sundyne, Tapflo, Vanton, Verder, Weir (Warman, GEHO), Wernert, others

Slurry & Sludge Centrifugal Pumps: Andritz, Boerger, C-P Pumpen, Duchting, Ebara, Flowserve, FLSmidth Krebs, Grindex, GIW, Hazleton, Hamworthy, KSB, Metso, ITT (Goulds, Flygt), Lawrence, Sero, Seepex, Shanghai Liancheng, Sulzer, Verder, Weir Minerals (Warman, GEHO), Wernert, Xylem (Godwin), Zoeller, others

General Service Centrifugal Pumps: Grundfos, Ebara, Flowserve, GE, ITT, KSB, SPXFlow, Sulzer, Weir, Xylem, others

Fire Pumps: Aurora, Fairbanks, Gorman-Rupp, IDEX (Hale), Patterson, Peerless, Ruhrpumpen, others

Cryogenic Pumps: Carter, Ebara, Hitachi, Nikisso, Shinko, SPX (David Brown), Sulzer, others.

HVAC Circulator Pumps

HVAC Circulator Pumps: Grundfos, Honeywell, KSB, Taco, Wilo, Xylem (Bell & Gossett), others

Artificial Lift Pumps

Progressive Cavity Pumps for Artificial Lift: Baker Hughes, Dover (Oil Lift Technologies), GE (Lufkin, Quinn), Kudu, NOV (Moyno, Monoflo, Robbins & Myers), Netzsch, PCM, Protex, others

Plunger Lift Pumps for Artificial Lift: Cameron, Dover (Harbison-Fisher, Ferguson-Beauregard), Flo-Well, GE (Lufkin, Quinn), Mega Lift Systems, Muth Pump, Weatherford, others

Sucker Rod Pumps (SRP) for Artificial Lift: Dover (Harbison-Fisher), Cameron, GE (Quinn, Lufkin), Muth Pump, NOV, Bosch Rexroth, others

Electric Submersible Pumps (ESP) for Artificial Lift: Baker Hughes (Centrilift), Canadian Oil Well Systems, CPTDC/China, Flowserve (Byron Jackson), GE (John Wood Group), Grundfos, Halliburton (Global Artificial Lift), ILI Technologies, JCS Alnas, Karma Artificial Lift, Lift Star, Novomet Artificial Lift, Schlumberger, Weatherford (Borets), others

Gas Lift for Artificial Lift: Baker Hughes, Flowserve, GE (Lufkin), PTC, Schlumberger (Camco), TGL, Weatherford, others

Metering Pumps

Metering Pumps: Accudyne (Milton Roy, LMI, Williams), Asti, Blue-White, Chongqing, Cole Parmer (Masterflex), Colfax (Zenith), Dover (Almatec, Neptune), Evoqua (Wallace & Tiernan), Graco (White Knight), Grundfos (Alldos), Emac, Flowrox, IDEX (Pulsafeeder, OBL, Trebor), Iwaki (Walchem), KNF, Larox, Lewa, Lutz-Jesco, Madden Mfg, McFarland Triton, Nippon Pillar, NOV (Moyno), Netzsch, ProMinent, Serfilco, seepex, Seko, Stenner, SPX (Bran & Luebbe), Spirax Sarco (Watson-Marlow, Qdos), Verder, Yamada, others

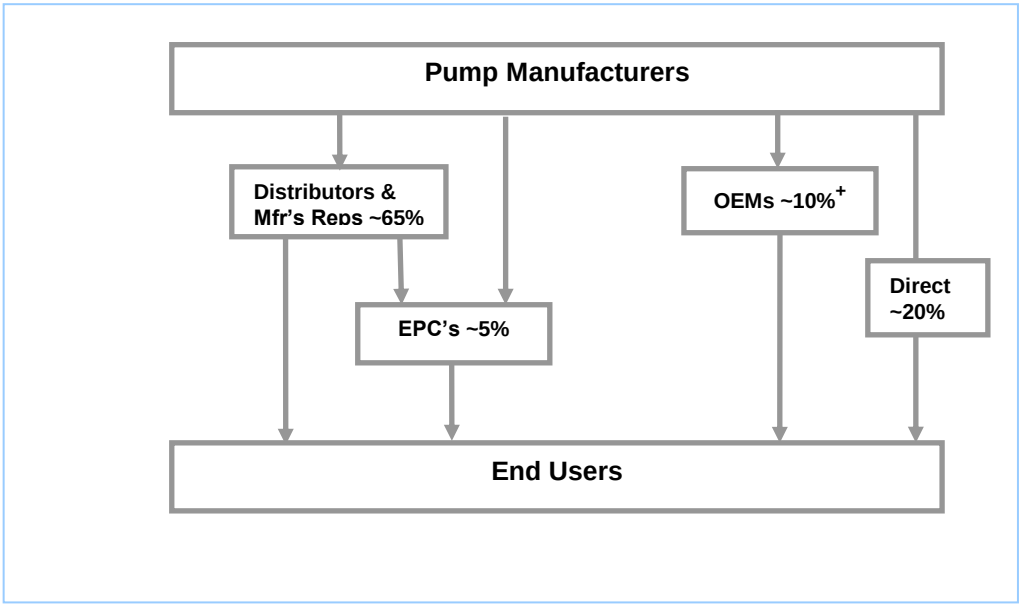
PUMP SUPPLIERS BY INDUSTRY

Following is a list of significant pump suppliers (not all inclusive) segmented by industry.

Industry	Application	Prominent Pump Suppliers by Industry
Food & Beverage, Pharmaceutical	Sanitary	Abel, Alfa Laval, Ampco, Boerger, Cole Parmer (Masterflex), CSF Inox, Discflo, Dover (Wilden), Fristam, GEA (Hilge), Graco, Gorman Rupp, Inoxpa, IDEX (Warren Rupp, Viking), JEC, KPA, Lobeflo, Muniflo, Robbins & Myers (Moyno), Omac, Packo, SRI, SPX (Waukesha Cherry-Burrell), Top Line Process, Tuthill, Xylem, others.
Semiconductor	Ultra-pure, and corrosive chemical	Almatec, Asti, Graco (White Knight), IDEX (Richter Chemie, Trebor), Iwaki, IDEX (Richter Chemie, Warren Rupp), Nippon Pillar, Yamada, others
Chemical	Corrosive/hazardous chemical	Andritz, ASV Stubbe, Blue White, Bungartz, ChemPump, CDR Pump, CP Pumpen, Duchting, Ebara, Finish Thompson, Flowserve, Friatec, Griswold, Hazelton, IDEX (Richter Chemie), ITT (Goulds), KSB, Lawrence, Lederle Hermetic, Lutz Jesco, March Pumps, Munsch, Price, Ruhrpumpen, Savino Barbera, SPX (Johnson Pump), Schmitt, Serfilco, Sulzer, Someflu, Sundyne, Tapflo, Vanton, Verder, Weir (Warman, GEHO), Wernert, others.
Oil & Gas, Refinery, Petrochemical	Pressure pumping	B&G, Bethlehem, Cameron (Lewco, LeTourneau), CAT Pumps, Dyna, Dragon Products, Finder, Flowserve, FMC Technologies, Frac Tech, Gardner Denver, Hammelmann, Lewa, Halliburton, Hebei Hengsheng, NOV, Procint, Pro-Source, Rodelta, SPXFlow (Clyde Union), Wanner Engineering, Weatherford, Weir, Wepuko, White Star, others
	High viscosity pumping	Colfax (Imo, Allweiler, Tushaco, Houttuin, Warren), IDEX, ITT (Bornemann), Kral, Leistritz, pcm, Robbins & Myers (Moyno), Roper, seepex, Saudi Pump Factory, Seemsan, Shanghai Huanggong, SPXFlow (Johnson Pump), Tarby, others
	Artificial lift	Baker Hughes (Centrilift), Dover (Ferguson-Beauregard, Oil Lift Technologies, Harbison Fisher), GE (Lufkin, Quinn), PCM, NOV Monoflo, Netzsch, Novomet, PCM, Robbins & Myers (Moyno), Schlumberger, Weatherford, others
Power	Boiler feed	Flowserve, ITT, KSB, Sulzer, SPX, Chongqing, Torishima, Weir, others
	Condensate	Flowserve, ITT, KSB, Sulzer, SPX, Weir, Chongqing
	Cooling	Flowserve, ITT, KSB, Sulzer, SPX, Weir, Chongqing
	Slurry	Aker-Wirth, Duchting, Hazleton, ITT (Goulds), Lawrence, Seepex, CP-Pump, Sulzer, Uraca, Verder, Weir (Warman, GEHO), Wernert, others
	Chemical metering	Accudyne (Milton Roy, LMI), Lutz-Jesco, Grundfos (Alldos), IDEX (Pulsafeeder), ProMinent, SPX (Bran+Luebbe), Stenner, Chongqing, others
Water & Watewater	Lift	Grundfos, Ebara, Flowserve, KSB, ITT (Goulds), Ovivo, Pentair, Sulzer, Wilo, Xylem, others
	Sludge	IDEX (SandPiper), Netzsch, Vogelsang, Wastecorp, Xylem, Zoeller, others
	Chemical metering	Accudyne (Milton Roy, LMI), Lutz-Jesco, Grundfos (Alldos), IDEX (Pulsafeeder, OBL), ProMinent, SPX (Bran+Luebbe), Stenner, others
Mining / Pulp & Paper	Dewatering, slurry, transport	Aker Wirth, GIW, Spirax-Sarco (Bredel), Grundfos, Grindex, ITT (Godwin, Flygt), Dover (Wilden), IDEX (Warren-Rupp), Ingersoll-Rand (ARO), Metso, SPX (Clyde-Union), Weir (Warman), Sulzer, others
De-Salination	Membrane feed	CAT Pumps, Flowserve, Sulzer, SPX, Xylem, others
Marine	Ballast water, bilge, water, boiler feed, cooling water	Allweiler, Buffalo Pumps, Carter, Carver, Colfax, Desmi, Dover PSG, Ebara, Grundfos, Hamworthy, Hitachi, IHC, Leistritz, Naniwa, Ruhrpumpen, Shinko, Shin Shin, seepex, Sulzer, Teiko Kikai, Verder, others

PUMP CHANNELS TO MARKET

Distribution is a critical component in pump marketing, and a robust infrastructure has evolved to service the millions of pump end users. The traditional distribution channels include: direct sales to end users; distributor sales; OEM sales; and sales to engineering, procurement, and construction specialists (EPC's). A general value-chain graphic is shown, below. It should be noted, however, that in some industries, such as food & beverage, OEM sales can be 60% or more of sales.



+ Note: Pump sales in the semiconductor, pharma/personal care and food & beverage industries are largely OEM sales involving skidded systems (90% OEM for pharma and 75% for food & beverage). Pump manufacturers increasingly offer skidded systems to customers.

Day-to-day sales

Distributor Sales

Distributor/Rep sales comprise the largest segment of the pump market, and service residential, commercial, and industrial customers. Distributors often align their business along specific industry lines. For example, a distributor handling lines of stainless steel pumps, valves, and fittings will focus on the sanitary industries including food & beverage, pharmaceutical, and bio-tech. Distributors handling semiconductor manufacturers may specialize in stainless steel or engineered plastic pumps and fittings. Some distributors may operate only locally, whereas others may be nationally or even internationally franchised with multiple outlets. The directories published by national associations of wholesalers & distributors are excellent resources for obtaining distributor lists segmented by industry.

"House" accounts

OEM Sales

A significant portion of pump sales are to large OEM accounts sometimes referred to as "national" or "house" accounts. Even though pricing may be highly competitive for OEM sales, these accounts are highly valued by the manufacturer because the orders are substantial, the product is often configured identically for each order, and there is usually a predictable demand, delivery, and payment schedule over many years. It is estimated that globally there are over 20,000 OEMs and service providers for pumps. Some of the major OEMs segmented by industry are listed below.

Semiconductor Industry OEMs

Semiconductor OEMs supply washing/rinsing, etching, and production equipment to the industry. Major OEMs include Applied Materials, Akrion, Celerity, Dainipon Screen, Edwards, FSI, Grand Plastics, Kanto, Kinetics, Lam Research, Marketech, Semitool, Semes, SEZ, Sumitomo, Syntonia, and Tokyo Electron.

Lubrication Industry OEMs

Lubrication OEMs supply skidded lubrication systems with reservoir tanks, pumps, valves, flow meters, filters, coolers, piping, and instrumentation for lubrication of turbines, compressors, generators, and other rotating equipment. Lubrication OEMs include Oil Filtration Systems, Filter Vac, Hilliard, Kaydon, Velcon, and others.

Cement Industry OEMs

OEMs supplying air-filtration systems to the cement industry (and also the power industry) include American Air Filter, CamCorp, Dantherm Filtration, Donaldson Torit, Flex Kleen, Mac Equipment, Midwesco, Mikropul, Pnuemafil, TechFlow, Tri-Mer, US Air Filtration, and others.

Pull-through demand for aftermarket sales.

There are many other OEMs supplying critical packaged systems with pumps for niche applications in virtually every industry sector. Identification of key OEMs is critical to successful pump marketing because of the "pull-through" demand OEM sales create for aftermarket pump and replacement parts sales.

EPC "projects"

Engineering, Procurement, and Construction (EPC's)

Major plant construction projects in industries such as power, water & wastewater, desalination, semi-conductor, chemical, refinery, petrochemical, and cement are handled by specialist engineering firms that assume responsibility for designing the plant, gathering all equipment specifications, selecting suppliers for major equipment, and engaging contractors for plant construction. Pump m*anufacturer relationships with engineering firms, and inclusion on "approved vendor" lists are critical to the marketing strategy for any pump manufacturer.*

EPC "approved vendor" lists

Various types of engineering specialists have emerged depending on the scope of responsibility assumed by the firm. Some are engaged in front-end engineering and design (FEED), others in engineering and procurement (EP's), others in engineering, procurement, and construction (EPC's), and others in engineering, procurement, construction, and management (EPCM's) with operating responsibilities after plant commissioning. In large projects, multiple EPC's may be engaged for different segments of the project. It has been estimated that globally there are over 8,000 EPC firms in operation, and short lists of major EPC's that handle a majority of world projects are listed below.

EPC's in Power *(sampling only)*

Alstom, Bechtel, Babcock & Wilcox, Buckman Labs, Chiyoda, Coalogix, Cormetech, Doosan, Ducon, Foster Wheeler, Fisia Babcock Environment, GE Water, Hamon, Hitachi, Hyundai Heavy Industries, Lauren Engineers, Marsulex, Mitsubishi, Nalco, Peerless, RM Technology, Roberts & Schaefer, Sargent & Lundy, SIDEM, Wuhan, Wahlco, India: Bharat Heavy Electricals (BHEL), Larson & Toubro (L&T), TechnipFMC, Thermax, Doosan, National Thermal Power Corp (NTPC): China: B&W Bejing, China Western Power Industrial, Chongqing Electric Power, Dongfang Electric Corp, Harbin Power Engineering, Hebei Electrical Construction, Shangdong Electric Power Engineering, others.

EPC's in Oil & Gas/Petrochemical/Refinery *(sampling only)*

ABB, Aker Solutions (Norway), Axens, Bechtel (USA), Black & Veatch, CB&I Chicago Bridge & Iron (purchased Shaw Group in 2012), Chiyoda (Japan), Clough Engineering, Daelim (S. Korea), Daewoo, Doosan, Exterran, EIL, Ferrostaal, Fluor, Foster Wheeler (USA), GE Energy, Global Industries, Hyundai Engineering & Construction (S. Korea), Haldor Topsoe, ITB, Intecsa, Jacobs Engineering, JGC (Japan), John Brown, Kawasaki, Kentz, KBR, Kobe, Linde, Larson & Toubro, Lamprell, Lurgi, M.W. Kellogg Ltd, Marie Technimont, McDermott International (USA), Mott McDonald, Mitsui Engineering, Mitsubishi Heavy Industries, Naizak, Ortloff, Petrofac, Propac, Penspen, Petrojet, Sinopec, Snamprogetti, Saipem, Samsung Engineering, SBM, Shaw Group, Sinopec Engineering, SK Engineering, SNC-Lavalin (Canada), Sofregaz, Technicas, TechnipFMC, Reunidas, Tartan, Topaz, Toyo Engineering, UOP, Unde, Wood Group, Worley Parsons, others.

EPC's in Water Treatment/DeSal *(sampling only)*
Accionia, Ambika Group, Black & Veatch, Burns & McDonnell, CH2MHill, Chennai, CB&I, Church & Dwight, Doosan, Foster-Wheeler, Enviro Solutions, Greeley & Hansen, Hatch Mott MacDonald, Hazen & Sawyer, HDO, JGC, Larson & Toubro, LG-Hitachi Water Solutions, Ovivo, Paramount, PD Naidoo, Punj Loyd, Samsung Engineering, Tetra-Tech, Tri-Tech Holdings, URS, Veolia, others.

EPC's in Cement *(sampling only)*

Ashoka Group, Babcock & Wilcox, Chanderpur Works, F.L. Smidth, Fives FCB, Global Consulting, Industrial Gears, Protech, Sabko Industries, others.

EPC's in Semi Conductor Fabs *(sampling only)*

CH2M Hill, Fluor, L&K Engineering, Jacobs Engineering, M+W Group, Samsung, others.

EPC's in Pharmaceutical /Chemical/Fertilizer Plants *(sampling only)*

CH2M Hill, Chiyoda, EPC Group, Fluor, L&K Engineering, Hyosung, JCG Group, Jacobs Engineering, Linde Engineering, Technip, others

The complete list is extensive and in many cases regional, particularly for the smaller plant builds.

Large construction projects will draw the attention of well-established international firms such as those named above.

PUMP OEMs AND END USERS BY MAJOR INDUSTRIES

Each industry sector includes thousands of pump end-users. Following are lists of major OEM or end-user customers, segmented by industry.

Semiconductor Industry

Major pump OEMs servicing the semiconductor industry include Applied Materials, Akrion, Celerity, Dainipon Screen, Edwards, FSI, Grand Plastics, Kanto, Kinetics, Lam Research, Marketech, Semitool, Semes, SEZ, Sumitomo, Syntonia, and Tokyo Electron.

A majority of semi-conductor foundry capacity is located in the Asia-Pacific region, specifically Japan, S. Korea, China and Taiwan. Major foundries include Global Foundries, Taiwan Semiconductor Manufacturing (TSM), United Microelectronics Company (UMC), Chartered Semiconductor Manufacturing (CHRT), and Semiconductor Manufacturing International (SMI). These companies account for over 70% of micro-chip production, worldwide. Other smaller-scale facilities are located elsewhere in Europe and in the Americas.

Water & Wastewater Industry

End users of pumps in the water and wastewater industry include the thousands of municipal government bodies, worldwide. Access to the markets is through local distributors, as well as through the large wastewater EPC firms such as Black & Veatch, Burns & McDonnell, CH2M Hill, Foster-Wheeler, Ovivo, Veolia, and many others listed earlier in this Report.

Oil & Gas Industry

End users of pumps in the oil & gas industry include the major oil & gas suppliers (majors), as well as the refinery companies. The “Majors” include British Petroleum, Chevron, Citgo, Conoco-Phillips, Exxon-Mobile, Irving Oil, Nippon Oil, Pemex, Petrobras, Saudi-Aramco, Shell, Sunoco, and others. Worldwide, there are over six hundred and fifty refineries that are serviced by local distributors, as well as through the large oil & gas EPC firms.

Chemical and Petrochemical

End users of pumps in the industrial chemicals and petrochemicals market include the majors such as BASF, Dow, DuPont, DeGussa, Eastman Chemical Company, Shell, Bayer, INEOS, ExxonMobile, SABIC, Braskem, Mitsubishi, Akzo Nobel, PPG, Shin-Etsu, Ecolab/Nalco, and others. Each of these companies operates numerous facilities throughout the world, collectively amounting to thousands of production sites. Additional to the majors are thousands of smaller independent chemical companies. Access to the markets is primarily through local distributors, as well as through the large EPC firms specializing in chemical plant design, construction, and procurement.

Mining

The mining industry is highly fragmented with hundreds of mining companies, worldwide. The Top 25 mining companies include: BHP Billiton, Vale, S.A., Rio Tinto, Arcelormittal, Anglo American, Plc, Xstrata Plc., RWE, Mitsubishi Corporation, Barrick Gold, Potash Corporation, Freeport Mcmoran, Goldcorp, Southern Copper Corp, Mosaic Company, Sasol Ltd, Newmont Mining, Wesfarmers Ltd, Companhia Siderurgica Nacional, Eurasian Natural Resources, American Electric Power, Anglo Platinum Ltd, Aluminum Corp of China, Antofagasta Ltd, Impala Platinum, Anglogold Ashanti. Usually, mining market research is segmented by industry, i.e., coal, iron, copper, precious metals, rare earths, etc.

Paints & Coatings

The Top 10 global coatings manufacturers are: Akzo Nobel nv, PPG Industries, DuPont Coatings, Sherwin-Williams, BASF Coatings, Valspar Corp, Kansai Paint, RPM International, Nippon Paint, and Jotun. The Top 25 coatings manufacturers in North America are: PPG, DuPont, Sherwin-Williams, Valspar, RPM International, Behr Process Corp, Comex, BASF Coatings, Benjamin Moore, Ennis Paint, Rohm & Haas, Dunn-Edwards, Kelly-Moore, Cloverdale Paint, TIGER Drylac, Nippon Paint (US), True Value, Vogel Paint, Ace Hardware, Spraylat Corp, Tnemec Co., Quest Specialty Chemical, Elantas PDG, Lord Corp, and Yenkin Majestic.

Food & Beverage

Major end users of pumps in the food & beverage industry are international processors including Anheuser-Busch, Con-Agra, Coca Cola, Danone Group, Dean Foods, General Mills, Kraft Foods, Nestle, PepsiCo, Swift, Tyson, Unilever Group, and others. Each of these companies and hundreds more maintain multiple production facilities throughout the world.

Pharmaceutical

Major end users of pumps in the pharmaceutical industry are the global drug companies and medical equipment suppliers including Abbott Laboratories, Bayer, Bristol-Myers-Squibb, Eli-Lilly, GlaxoSmithKline, Johnson & Johnson, Merck, Novartis, Pfizer, Roche, Sanofi Aventis, and others. Industry research analysts have identified over 1,500 additional companies in the United States involved in the manufacturing of pharmaceutical chemicals and end products.

Pulp & Paper

Major end users of pumps in pulp & paper are the global paper companies including International Paper, Kimberly-Clark, Metsaliitto, Mondi Group, Nippon Unipac, Oji Paper, SCA, Smurfit Kappa, Stora Enso, and UPM. Paper production is highly regional, with significant production in the United States, Sweden, Finland, Ireland, Japan, the UK, and South Africa, but with the greatest percentage now occurring in China.

TRENDS AND TREND DRIVERS

Trends and drivers in pump sales can be segmented as listed below:

- By national economic policy
- By geographic region
- By industry, and
- By technology

National Economic Policy Trends

National economic trade policy in most developing countries is designed to encourage domestic manufacture of industrial equipment by domestic suppliers. This will likely lead to increasing challenges for Western pump manufacturers to maintain traditional levels of equipment sales. However, it will also likely lead to a renaissance in innovation among western suppliers to retain market competitiveness, and this will be a positive development for the industry.

Geographic Trends

Despite the forecasted slowdown of growth in China and some other Asian countries, the absolute magnitude of growth in China and India will outpace growth in the developed economies of North America and western Europe, and the developing countries in South America. The higher level of growth, combined with the size of the economies in China, India, and South Korea make Asia the most attractive global market by Region. Growth drivers continue to be improvement in the standard of living, and increased urbanization of the populations. The most conservative of GDP projections for China at 6.5% are more than twice the rate of projected growth for developed nations. In 2016, Iran opened its market for foreign companies and this holds a significant promise because of the re-build of infrastructure.

Industry Trends

The industries most directly linked to basic human services and consumables can be expected to outperform other industries, and without the volatility recently experienced in the oil & gas markets and mining markets.

Attractive industries include:

- power generation,
- water & wastewater treatment, and
- food & beverage, and pharmaceuticals production

Power generation will be driven by **load growth** in developing nations, and by **fleet restructuring** (from coal to gas or renewables) in the developed countries. However, a “power bubble” in China built up over the past 5 years could lead to reduced construction of coal-fired plants in the near term. Japan presents a potentially large

opportunity in power pending resolution of national policy concerning the approximately 50 nuclear power plants that are currently off the grid following the Fukushima natural disaster.

Industries that will continue to face near-term challenges include:

- Oil & gas
- Mining
- Pulp & Paper, and
- Marine

Volatility in **oil & gas** will persist as long as there is an oversupply of oil relative to demand. The current agreement among OPEC countries to limit production may help to increase oil prices, but the re-introduction of Iranian oil into world markets may offset the OPEC cutbacks, and cutbacks in North American production. The situation will be monitored by Resolute Research.

The **mining industry** has experienced a setback following the oil-price collapse that began in 2014. This rides on top of a more general and long-term trend that has seen mining operations shifting to developing nations in Asia and South America, creating significantly diminished opportunities in the developed nations in Europe and North America.

As with other industries, the attraction of lower-cost construction outside of Europe and North America created a pivot to Asia such that currently Japan, S. Korea, and China account for most of the world's merchant ship construction.

The peak construction and consequent oversupply of tonnage in 2010, plus a falloff in demand for oil tankers with the development of shale oil in North America has caused a downward trend in the marine industry. Offsetting factors include a projected need for additional LNG tankers to transport North American and Middle East natural gas to energy-hungry Asian countries; however, this could be negatively impacted by overland supply of gas from Russia to China.

A significant positive opportunity for pumps and valves in the marine industry is driven by national and international environmental legislation that mandates new ballast water treatment systems and flue gas scrubbing systems for the nearly 70,000 merchant vessels, worldwide. This legislation is already active in certain countries and is driving sales of centrifugal pumps for ballast and bilge water, and slurry pumps for treatment of flue gas in the retrofit market.

The **pulp and paper industry** had for many years been concentrated in the United States, and several European countries including Finland, Sweden, Germany, and the United Kingdom. Going back several decades, lower production costs and increased local demand supported a major relocation initially to Japan, soon to be followed by China and several other Asian countries. Today, China accounts for more than 25% of paper production, and has supplanted the United States as the world leader. In total, Asia now accounts for more than 45% of total worldwide paper production. This trend has led to the decline of paper production capacity in the traditional western nations.

Another trend in the industry has been the general decline in demand for printed media (newspapers, magazines, and books) due to the digital era and downloadable digital media. This, too, has negatively impacted industry growth over the past decade. The industry was able to partially offset the decline in the print segment with increased production in the packaging and paper-board markets, which has helped to stabilize the industry. That notwithstanding, Asian producers have benefited the most and that trend is likely to continue.

Product & Technology Trends

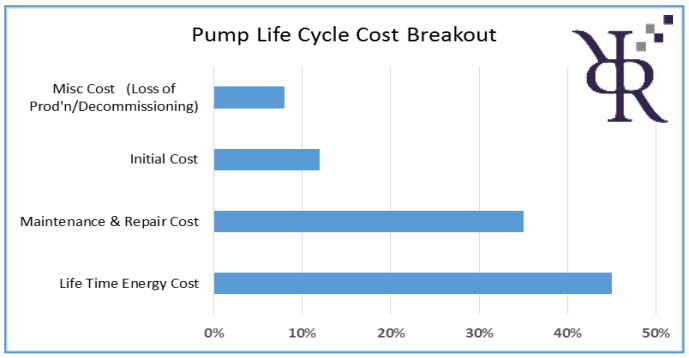
Product and technology trends will likely focus on the following opportunities:

- Energy conservation
- Environmental protection, and
- Expanded pump capabilities for severe service applications

Energy Conservation: A recent Hydraulics Institute study has estimated that more than 27% of energy consumed in industrial plants is used by pumps. This is a market driver for innovations and increased efficiency in motors. Additionally, variable speed drives for pumps will be increasingly used in preference to throttling valves where possible as a means to increase overall system operating efficiency, and to reduce energy consumption. In another development, the US Department of Energy (DOE) published in January 2016 a Pump Efficiency Rule scheduled for enforcement in the US in January 2020 that will set new efficiency standards for certain pumps primarily involving centrifugal pumps in the end-suction close coupled and frame mounted style, in-line pumps, radially split multi-stage pumps, and submersible turbine pumps.

This efficiency standard will apply to those commercial or industrial clean water pumps that operate between 1 and 200 horsepower (some pumps will be exempted). There will be minimal impact on end users aside from the beneficial improvements in efficiency, which will be noted by labels affixed to the pumps indicating Rule compliance. Modifications to pump casings, impellers, diffusers, seals, parts surface finish, and variable speed drivers are among the modifications manufacturers can implement to achieve the higher efficiencies.

The **life cycle cost (LCC)** of a pump varies with the pump type and application. On an average basis, the initial price is a relatively small percentage of LCC and other factors most notably energy efficiency can be expected to play an increasing role in purchasing decisions in the future. The Hydraulic Institute has published a white paper called "Pump Life Cycle Costs: A Guide to LCC Analysis for Pumping Systems" that provides more in-depth analysis of this topic.



Positive displacement (pd) pumps are generally more efficient than centrifugal pumps, and this will favor increased use of pd pumps such as vane, gear, piston, peristaltic, screw, and diaphragm where centrifugal pumps may be used today.

Additional focus on system evaluations to "right size" the pump and avoid pump oversizing is another trend that can be expected to increase overall efficiency and reduce operating costs.

Environmental Protection: There will be increased focus on sealed pumps in response to more stringent environmental regulations regarding fluid and gas leakage to the environment. Technologies poised to benefit include mag-drive centrifugal pumps, canned-motor pumps, peristaltic pumps, and diaphragm pumps applied in the oil & gas, refinery, petrochemicals, and chemicals markets.

Additionally, increased application of closed loop cooling systems to replace "once-through" cooling of condensers in power plants will drive additional sales of centrifugal circulating pumps and chemical injection pumps. These changes will be especially focused on water stressed regions throughout the world.

Technology and Severe Service Innovations: There are also trends to better address severe service applications. These product and technology innovations will likely include:

- Increasing focus on improved materials of construction, such as duplex stainless steels and engineered plastics to increase safety and reduce downtime and loss of production, especially in severe applications in the power, refinery, chemical, and desalination industries, among others.
- Higher pressure multi-stage centrifugal pumps operating at pressures beyond 3,000 psi and temperatures beyond 1,000F for boiler feed to service the higher operating pressures and temperatures of super-critical and ultra-super-critical steam boilers in the electric power market. These pumps will continue to be in demand in China, India, Vietnam, and other Asian countries for power plants.
- Growth in metering pump sales at above-GDP rates to meet the growing demand for chemical dosing of severely polluted water, such as flow-back frac water and produced water in the upstream oil & gas industry.
- Increased use of oil-less magnetic bearings for high-capital-cost rotating equipment including large pumps, compressors, and turbines. Gear, ~~and~~ progressing cavity, and screw type lubrication pumps may begin to see some level of reduced sales as the technology for oil-less magnetic bearings gains traction in more markets. Currently, magnetic bearings are making inroads in pumps used in semiconductor manufacturing and compressors in oil & gas. Widespread adoption of magnetic bearings has been slow due to cost and technology issues, but is likely to have an impact over the long term.

Each of the above-listed trends is tempered by general economic activity, but these applications should outperform other sectors and provide opportunities for pump manufacturers even in a generally low-growth environment. The following table (which you can find on the next page) provides a high-level summary of expected trends over the upcoming 5-year period.

Industry Sector	Growth Trends				Comments
	OECD Countries		Developing countries		
	1-Yr History	5-Yr Forecast	Recent History	5-Yr Forecast	
Water	GDP	> GDP	> GDP	> GDP	Infrastructure rebuild in OECD; New builds in developing
Food & Bev	GDP	> GDP	> GDP	> GDP	Population driven expansion
Pharma	> GDP	> GDP	> GDP	> GDP	Population driven expansion
Power	< GDP	GDP	> GDP	> GDP	Low load growth in OECD; load growth in developing
Oil & Gas	< GDP	GDP	> GDP	> GDP	Low demand growth in OECD; demand growth in developing
Refinery	< GDP	GDP	> GDP	> GDP	Low demand growth in OECD; demand growth in developing
Mining	< GDP	< GDP	> GDP	> GDP	High extraction costs in OECD; new resources in developing
Pulp & Paper	< GDP	< GDP	GDP	GDP	Slowdown re digital era; low cost production in developing
SemiCon	< GDP	< GDP	GDP	GDP	Tapering of growth in OECD consumer electronics
Marine	< GDP	< GDP	GDP	GDP	Working off current over capacity

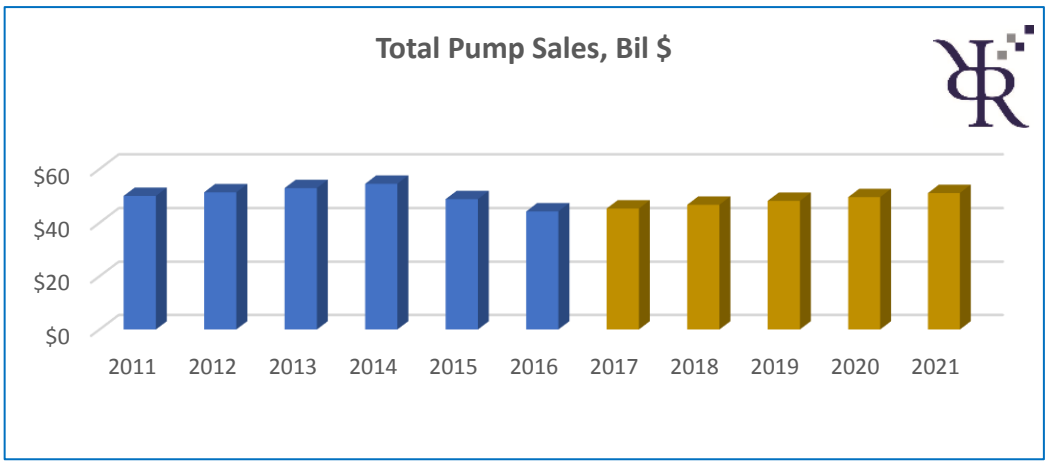
As a closing note, capital goods sales including pump sales, could improve in 2017 in the United States due to a roll-back in what some consider excessive environmental oversight by the EPA, and as a result of increased activity in oil & gas pipelines, gas turbine and possibly coal-fired power plants, and general infrastructure spending, including in water & wastewater treatment, promised by the incoming new Administration. The situation will be closely monitored by Resolute Research.

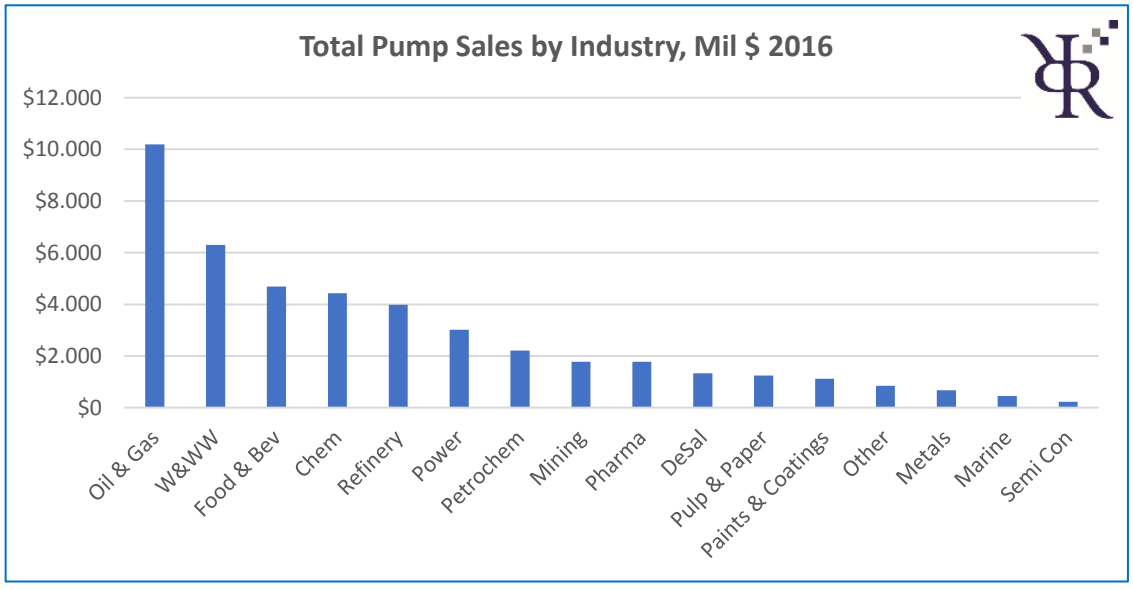
APPENDIX I. Country Listings

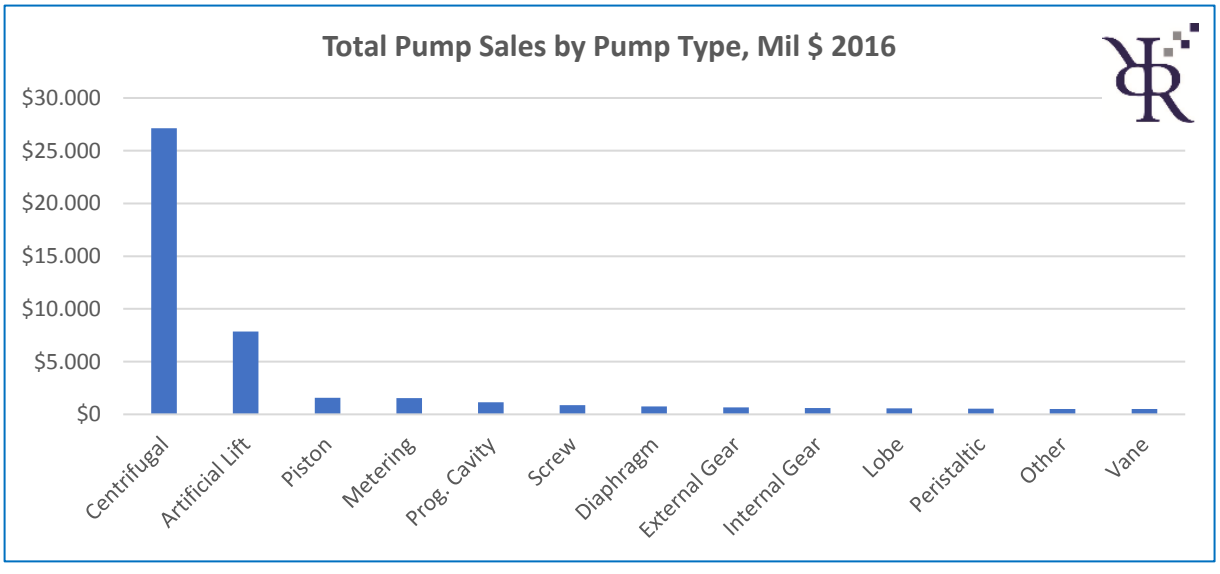
Over 60 countries (listed below) and comprising more than 96% of world GDP are included in the analyses provided in this report, and in the Resolute Research Pump Data Base that is available by separate order.

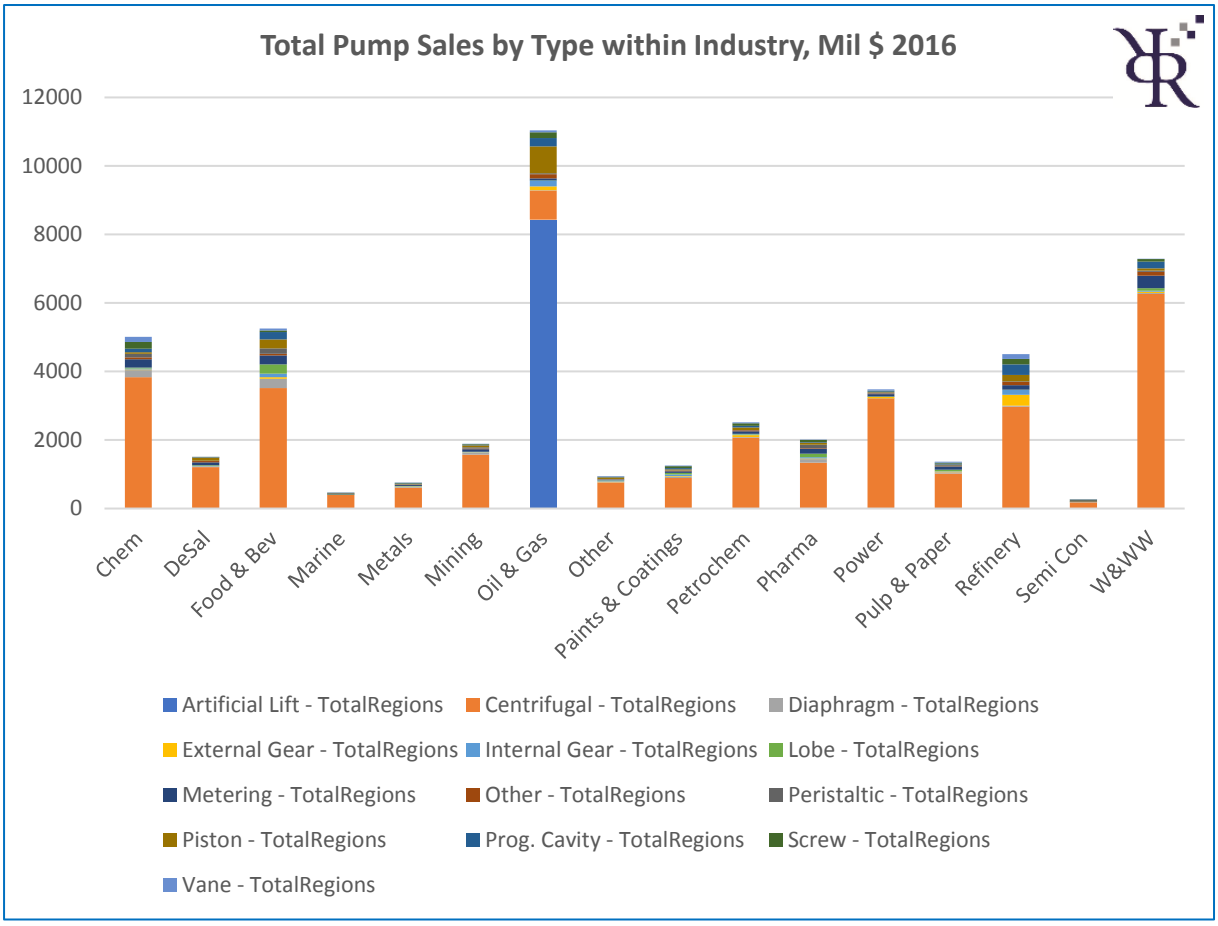
Algeria	Iran	Romania
Angola	Iraq	Russia
Argentina	Ireland	Saudi Arabia
Australia	Israel	Singapore
Austria	Italy	Slovakia
Bangladesh	Japan	South Africa
Belgium	Kazakhstan	Spain
Brazil	Korea, South	Sweden
Canada	Kuwait	Switzerland
Chile	Libya	Taiwan
China	Malaysia	Thailand
Colombia	Mexico	Turkey
Czech Republic	Morocco	Ukraine
Denmark	Netherlands	United Kingdom
Egypt	Nigeria	United States
Finland	Norway	Venezuela
France	Pakistan	Vietnam
Germany	Peru	New Zealand
Greece	Philippines	UAE
Hungary	Poland	
India	Portugal	
Indonesia	Qatar	

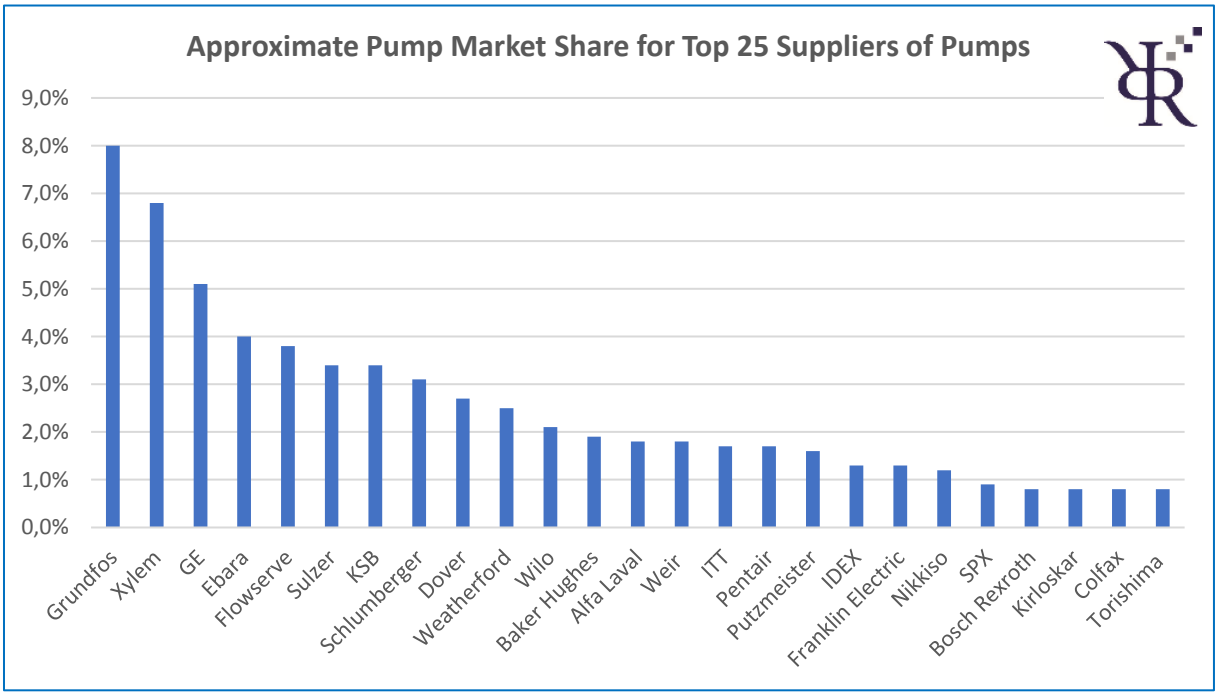
APPENDIX II. Market Snapshots

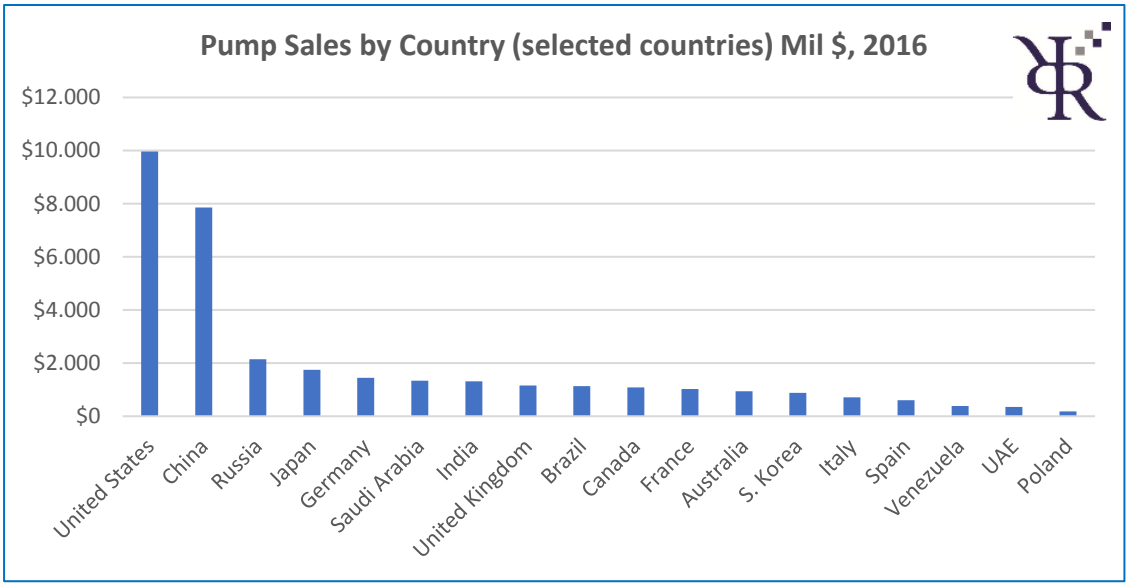


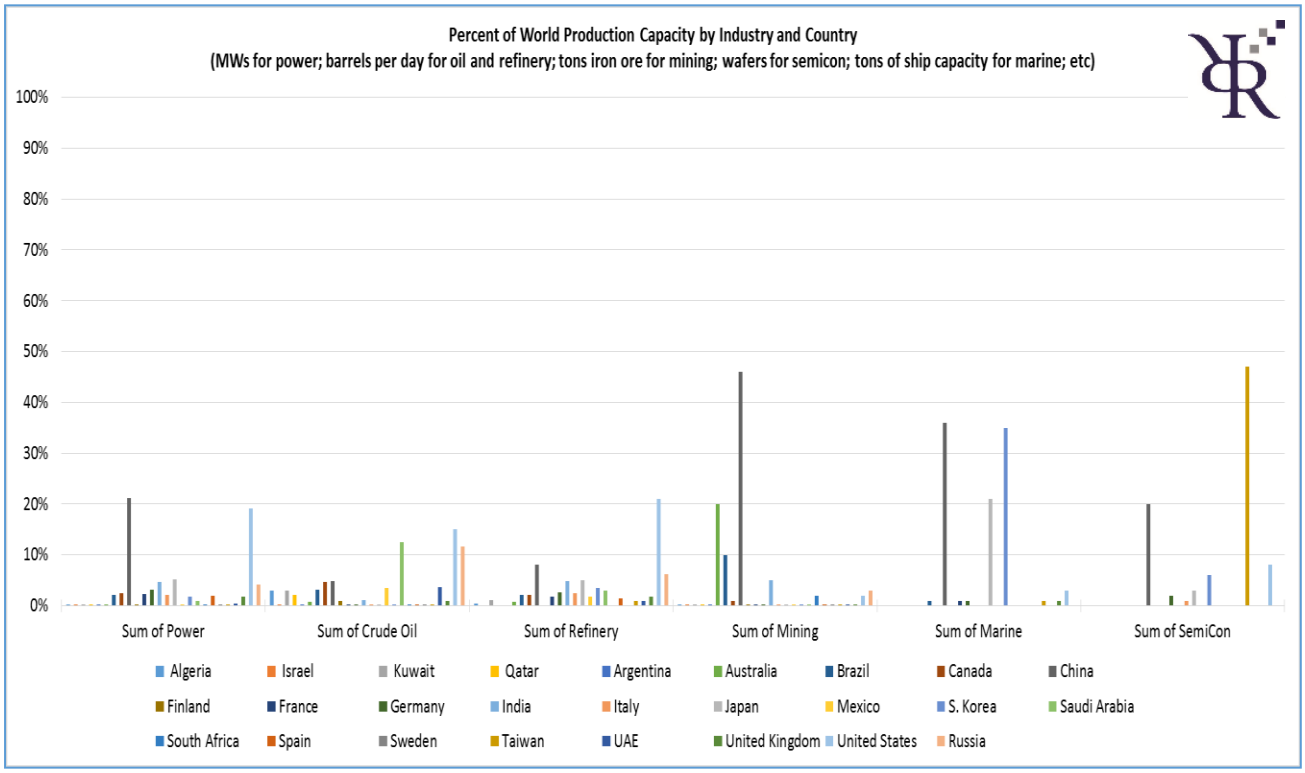












Sample Output from Pump Product Data Base (available separately from Resolute Research)

Region	Country	Industry	Products	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
All Regions	All Countries	All Industries	All Products	$48,801.3	$50,435.4	$51,829.9	$53,422.9	$55,061.5	$49,227.5	$50,037.8	$51,501.2	$53,235.4	$55,071.6	$56,994.7
N. America	United States	Power	Centrifugal	$251.91	$256.00	$262.03	$267.92	$274.51	$245.30	$247.76	$250.23	$253.99	$257.80	$261.66
Asia	China	Power	Centrifugal	$1,303.40	$1,440.23	$1,562.07	$1,692.38	$1,825.65	$1,631.40	$1,729.29	$1,833.04	$1,944.86	$2,068.03	$2,199.00
Asia	Japan	Power	Centrifugal	$43.56	$43.34	$44.14	$44.86	$44.81	$40.04	$40.04	$40.22	$40.49	$40.86	$41.15
W. Europe	Germany	Power	Centrifugal	$93.70	$97.30	$97.69	$97.99	$99.58	$88.99	$90.39	$91.75	$92.94	$94.14	$95.34
W. Europe	France	Power	Centrifugal	$22.50	$22.98	$23.03	$23.19	$23.24	$20.76	$21.07	$21.41	$21.79	$22.19	$22.60
W. Europe	United Kingdom	Power	Centrifugal	$14.50	$14.79	$14.97	$15.31	$15.77	$14.09	$14.40	$14.72	$15.05	$15.38	$15.70
S & C America	Brazil	Power	Centrifugal	$18.27	$19.01	$19.36	$19.90	$19.92	$17.80	$17.44	$17.83	$18.26	$18.70	$19.18
W. Europe	Italy	Power	Centrifugal	$13.33	$13.41	$13.05	$12.83	$12.78	$11.42	$11.57	$11.70	$11.83	$11.95	$12.07
Asia	India	Power	Centrifugal	$507.84	$543.73	$572.95	$615.41	$663.87	$593.24	$634.76	$682.63	$734.83	$791.37	$852.65
N. America	Canada	Power	Centrifugal	$24.92	$25.70	$26.19	$26.73	$27.38	$24.47	$24.88	$25.48	$26.07	$26.63	$27.16
CIS	Russian Federation	Power	Centrifugal	$38.38	$40.11	$41.52	$42.07	$42.32	$37.82	$37.06	$37.43	$37.99	$38.56	$39.14
W. Europe	Spain	Power	Centrifugal	$12.93	$12.81	$12.48	$12.27	$12.45	$11.12	$11.41	$11.66	$11.89	$12.12	$12.34
Asia	Australia	Power	Centrifugal	$9.66	$9.90	$10.27	$10.52	$10.79	$9.64	$9.92	$10.22	$10.52	$10.83	$11.14
N. America	Mexico	Power	Centrifugal	$9.60	$9.99	$10.40	$10.55	$10.79	$9.64	$9.91	$10.22	$10.55	$10.90	$11.26
Asia	S. Korea	Power	Centrifugal	$16.13	$16.75	$17.14	$17.65	$18.26	$16.31	$16.83	$17.43	$18.06	$18.70	$19.37
W. Europe	Netherlands	Power	Centrifugal	$4.10	$4.17	$4.13	$4.11	$4.15	$3.71	$3.78	$3.85	$3.92	$4.00	$4.08
Middle East	Turkey	Power	Centrifugal	$1.72	$1.89	$1.93	$2.01	$2.07	$1.85	$1.91	$1.98	$2.05	$2.12	$2.19
Asia	Indonesia	Power	Centrifugal	$4.59	$4.90	$5.21	$5.52	$5.81	$5.19	$5.46	$5.76	$6.09	$6.45	$6.84
W. Europe	Switzerland	Power	Centrifugal	$2.33	$2.37	$2.40	$2.44	$2.49	$2.22	$2.25	$2.29	$2.33	$2.38	$2.42
E. Europe	Poland	Power	Centrifugal	$5.92	$6.23	$6.34	$6.42	$6.64	$5.93	$6.14	$6.36	$6.59	$6.82	$7.07
W. Europe	Belgium	Power	Centrifugal	$3.21	$3.27	$3.28	$3.28	$3.32	$2.97	$3.01	$3.05	$3.10	$3.15	$3.19
W. Europe	Sweden	Power	Centrifugal	$5.47	$5.62	$5.61	$5.68	$5.81	$5.19	$5.34	$5.49	$5.63	$5.75	$5.88
Middle East	Saudi Arabia	Power	Centrifugal	$6.63	$7.37	$7.79	$8.01	$8.30	$7.42	$7.58	$7.80	$8.03	$8.28	$8.55
Asia	Taiwan	Power	Centrifugal	$8.19	$8.36	$8.53	$8.79	$9.13	$8.16	$8.37	$8.61	$8.87	$9.15	$9.44
W. Europe	Norway	Power	Centrifugal	$5.43	$5.49	$5.64	$5.68	$5.81	$5.19	$5.26	$5.34	$5.44	$5.55	$5.67
Middle East	Iran	Power	Centrifugal	$8.31	$8.63	$8.09	$7.94	$8.30	$7.42	$7.74	$8.05	$8.38	$8.75	$9.13
W. Europe	Austria	Power	Centrifugal	$2.38	$2.45	$2.47	$2.48	$2.49	$2.22	$2.26	$2.29	$2.32	$2.34	$2.37
S & C America	Argentina	Power	Centrifugal	$4.37	$4.77	$4.81	$4.95	$4.98	$4.45	$4.42	$4.42	$4.42	$4.43	$4.44
Africa	South Africa	Power	Centrifugal	$9.08	$9.38	$9.59	$9.81	$9.96	$8.90	$9.02	$9.21	$9.44	$9.68	$9.94
Asia	Thailand	Power	Centrifugal	$5.15	$5.19	$5.60	$5.76	$5.81	$5.19	$5.36	$5.55	$5.74	$5.93	$6.12
W. Europe	Denmark	Power	Centrifugal	$1.64	$1.66	$1.65	$1.64	$1.66	$1.48	$1.51	$1.54	$1.58	$1.61	$1.65
W. Europe	Greece	Power	Centrifugal	$2.99	$2.74	$2.55	$2.47	$2.49	$2.22	$2.20	$2.26	$2.33	$2.39	$2.45
Middle East	UAE	Power	Centrifugal	$2.67	$2.82	$3.03	$3.17	$3.32	$2.97	$3.06	$3.16	$3.27	$3.39	$3.52
S & C America	Venezuela	Power	Centrifugal	$4.62	$4.82	$5.11	$5.18	$4.98	$4.45	$4.09	$3.91	$3.79	$3.75	$3.72
S & C America	Colombia	Power	Centrifugal	$1.76	$1.88	$1.96	$2.06	$2.16	$1.93	$1.98	$2.05	$2.12	$2.20	$2.29
W. Europe	Finland	Power	Centrifugal	$3.16	$3.25	$3.20	$3.17	$3.15	$2.82	$2.84	$2.88	$2.91	$2.95	$3.00
Asia	Malaysia	Power	Centrifugal	$3.19	$3.37	$3.57	$3.74	$3.98	$3.56	$3.72	$3.91	$4.10	$4.31	$4.52
W. Europe	Portugal	Power	Centrifugal	$1.94	$1.90	$1.83	$1.81	$1.83	$1.63	$1.66	$1.68	$1.70	$1.72	$1.74
Asia	Singapore	Power	Centrifugal	$1.40	$1.49	$1.54	$1.61	$1.66	$1.48	$1.53	$1.58	$1.63	$1.68	$1.73
Africa	Egypt	Power	Centrifugal	$4.88	$4.97	$5.09	$5.19	$5.31	$4.75	$4.95	$5.17	$5.41	$5.68	$5.97
Middle East	Israel	Power	Centrifugal	$1.95	$2.05	$2.11	$2.18	$2.24	$2.00	$2.07	$2.13	$2.20	$2.26	$2.32
W. Europe	Ireland	Power	Centrifugal	$1.06	$1.08	$1.09	$1.10	$1.16	$1.04	$1.08	$1.11	$1.15	$1.18	$1.21
S & C America	Chile	Power	Centrifugal	$2.15	$2.28	$2.42	$2.52	$2.57	$2.30	$2.36	$2.42	$2.50	$2.58	$2.67
Africa	Nigeria	Power	Centrifugal	$0.67	$0.70	$0.74	$0.78	$0.83	$0.74	$0.77	$0.81	$0.85	$0.89	$0.93
Asia	Philippines	Power	Centrifugal	$1.89	$1.96	$2.10	$2.26	$2.41	$2.15	$2.29	$2.43	$2.59	$2.76	$2.94
E. Europe	Czech Republic	Power	Centrifugal	$3.23	$3.30	$3.27	$3.25	$3.32	$2.97	$3.04	$3.12	$3.19	$3.26	$3.33
Asia	Pakistan	Power	Centrifugal	$3.27	$3.36	$3.48	$3.64	$3.82	$3.41	$3.56	$3.73	$3.92	$4.12	$4.34
E. Europe	Romania	Power	Centrifugal	$2.45	$2.48	$2.49	$2.58	$2.66	$2.37	$2.46	$2.55	$2.63	$2.71	$2.80
Africa	Algeria	Power	Centrifugal	$1.39	$1.43	$1.47	$1.52	$1.58	$1.41	$1.46	$1.52	$1.58	$1.63	$1.69
S & C America	Peru	Power	Centrifugal	$1.07	$1.15	$1.22	$1.30	$1.33	$1.19	$1.23	$1.29	$1.36	$1.42	$1.48
CIS	Kazakhstan	Power	Centrifugal	$2.56	$2.76	$2.91	$3.09	$3.24	$2.89	$2.96	$3.07	$3.20	$3.33	$3.48
Asia	New Zealand	Power	Centrifugal	$1.70	$1.74	$1.78	$1.83	$1.83	$1.63	$1.67	$1.71	$1.75	$1.80	$1.84
CIS	Ukraine	Power	Centrifugal	$7.88	$8.31	$8.33	$8.33	$7.80	$6.97	$7.11	$7.36	$7.65	$7.95	$8.27
Middle East	Kuwait	Power	Centrifugal	$1.76	$1.95	$2.08	$2.11	$2.07	$1.85	$1.90	$1.95	$2.01	$2.06	$2.12
E. Europe	Hungary	Power	Centrifugal	$1.49	$1.51	$1.49	$1.52	$1.58	$1.41	$1.44	$1.48	$1.51	$1.54	$1.57
Middle East	Qatar	Power	Centrifugal	$0.63	$0.72	$0.76	$0.80	$0.83	$0.74	$0.78	$0.81	$0.84	$0.87	$0.89
Asia	Bangladesh	Power	Centrifugal	$1.09	$1.16	$1.25	$1.32	$1.41	$1.26	$1.35	$1.44	$1.54	$1.65	$1.76
Asia	Vietnam	Power	Centrifugal	$2.36	$2.52	$2.66	$2.81	$2.99	$2.67	$2.84	$3.01	$3.19	$3.38	$3.59
Africa	Morocco	Power	Centrifugal	$0.71	$0.75	$0.77	$0.81	$0.83	$0.74	$0.77	$0.81	$0.85	$0.89	$0.94
E. Europe	Slovakia	Power	Centrifugal	$1.07	$1.10	$1.12	$1.13	$1.16	$1.04	$1.08	$1.11	$1.15	$1.19	$1.22
Africa	Angola	Power	Centrifugal	$0.17	$0.17	$0.17	$0.17	$0.17	$0.15	$0.15	$0.16	$0.17	$0.17	$0.18
Middle East	Iraq	Power	Centrifugal	$1.13	$1.23	$1.42	$1.53	$1.49	$1.33	$1.43	$1.54	$1.66	$1.79	$1.92
Africa	Libya	Power	Centrifugal	$4.30	$2.65	$1.64	$1.44	$1.16	$1.04	$1.06	$1.12	$1.22	$1.33	$1.51
OtherRegions	Other	Power	Centrifugal	$49.06	$50.06	$51.09	$52.13	$53.19	$47.53	$47.53	$48.86	$50.17	$51.29	$52.29
TotalRegions	Total	Power	Centrifugal	$2,580.82	$2,771.47	$2,936.06	$3,122.63	$3,319.37	$2,966.19	$3,114.52	$3,279.71	$3,459.15	$3,654.70	$3,862.98

APPENDIX lll. About Resolute Research BV

Resolute Research BV is an industrial market research specialist. We provide clients with high-quality market intelligence, including complete development of market drivers, suppliers, distribution channels, growth opportunities, trends, threats, and other market dynamics.

The aspect what makes Resolute Research BV unique in what we do is the focus on carefully chosen markets. Resolute Research BV does not conduct research in all markets but on a set determined markets. These markets are all linked to the process industry.

Our experience spans major industries including oil & gas, refinery, petrochemical, chemical, power, metals & mining, pulp & paper, food & beverage, pharmaceutical, semiconductor, water and wastewater, desalination, and marine. Other industry segmentations can be developed on request.

We recognize that today's on-the-go business executives do not have the Staff or time to digest multi-hundred page reports that may inefficiently address customer needs. Accordingly, Resolute Research BV specializes in providing focused yet highly granular reports with essential narrative backed up with high-impact graphs, charts, and process flow diagrams.

The Resolute Research BV promise to clients is that we will provide an easy-to-read yet detailed market analysis completely aligned with client expectations. The big picture overview with all appropriate segmentations and high-granularity breakouts is what we are all about.

Resolute Research BV would be pleased to be your preferred source for industrial market intelligence.