Industrial Valve Summit

May 27-28, 2015 Bergamo, Italy

Valve Market Overview
Power and Oil & Gas Industries

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President, McIlvaine Company

Objectives:

- Provide high level overview of valve market size and growth prospects
- Identify market drivers and threats
- Identify emerging trends and opportunities

Scope:

- **Products:** Valves and valve actuators
- **Markets:** Power, Oil & Gas, others
- **Applications:** Special focus on severe service valves
- **Region:** World overview

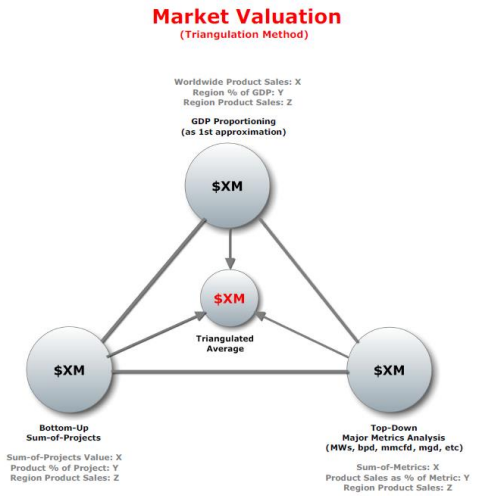
Venue:

- Industrial Valve Summit, Bergamo, Italy, May 27-28, 2015

Methodology:

Market Sizing and Projections:

- **Bottom-up analysis** reflecting ongoing and planned project work
- **Top-down analysis** of macro market metrics including new MWs (for power), new bpd (for refinery), new mmcfd (for gas)
- **McIlvaine custom research**, including sum-of-sales analysis for suppliers, and other custom research for market size validation

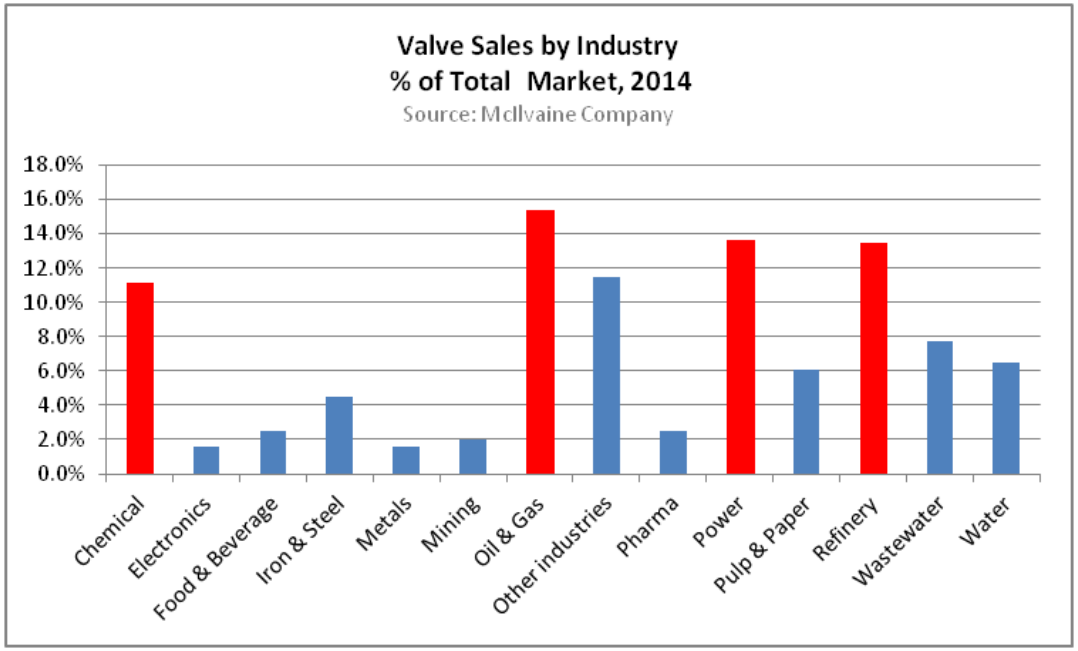


Research Sources:

- McIlvaine primary research with suppliers, EPCs, and end users
- McIlvaine network of niche expert consultants and field resources
- Data mining within McIlvaine proprietary data base
- General research

Big Picture Overview

Valve Sales by Industry (%)

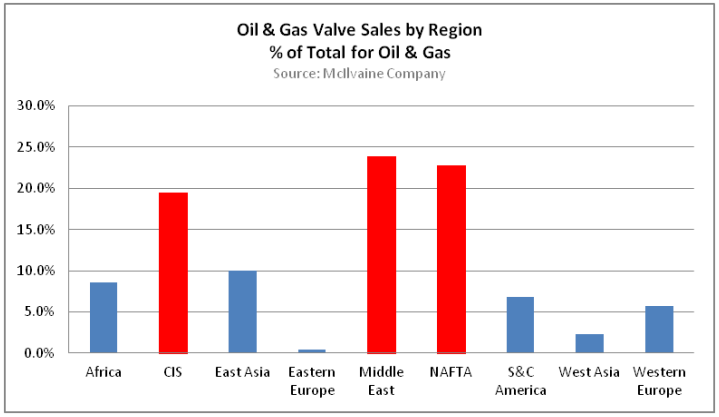


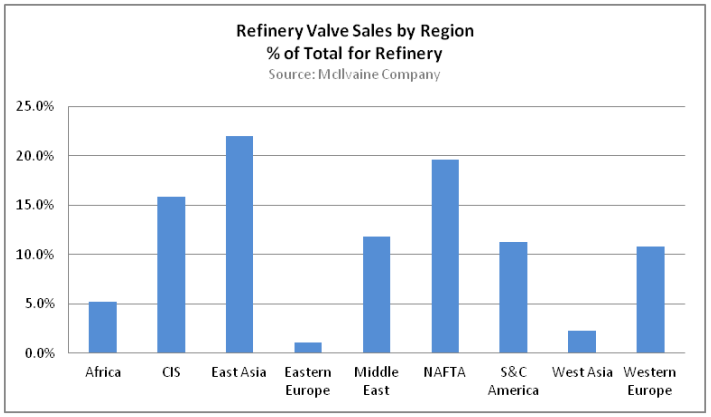
Industry	2015	2019
Chemical	6,470.23	7,649.03
Electronics	460.89	525.04
Food	1,471.42	1,719.65
Iron & Steel	2,686.86	3,418.82
Metals	928.69	1,084.66
Mining	1,193.05	1,477.83
Oil & Gas	8,742.44	9,379.90
Other Electronics	474.57	576.85
Other Industries	6,635.90	7,255.42
Pharmaceutical	1,496.63	1,732.69
Power	7,716.85	8,806.69
Pulp & Paper	3,534.21	4,207.23
Refining	7,731.28	9,081.64
Wastewater	4,384.30	4,696.76
Water	3,822.05	4,677.

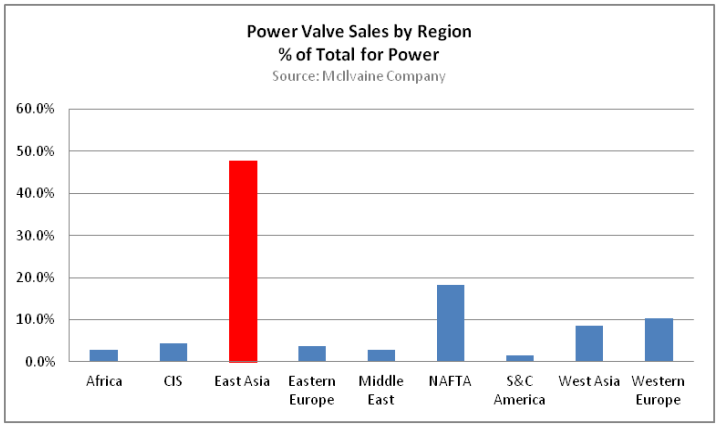
Narrative

+ Oil & Gas (upstream & midstream), Refinery (downstream), Power, and Chemical generate more than 50% of all valve sales, worldwide.

Valve Sales by Geographic Market Segment (%)







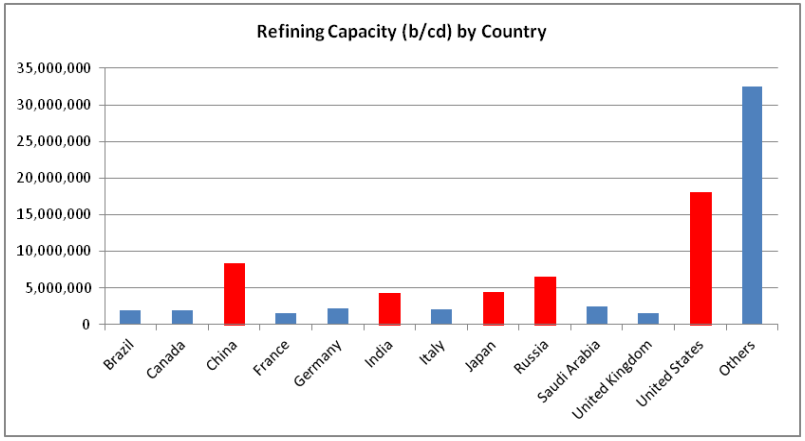
Narrative

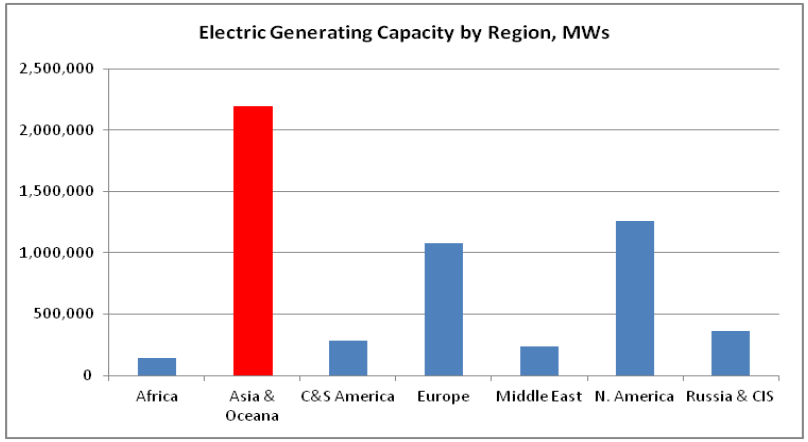
+ The rising position of NAFTA and CIS in the oil & gas market is shown in the first illustration.

+ The rising position of East Asia (China) in the refining sector is shown in the second illustration.

+ The overwhelming dominance of East Asia (China) in the power-gen market is shown in the third illustration. China has recently (March 2015) re-started approving licensing for new nuclear reactors that were put on hold after the Fukushima disaster. Currently, China has 26 new nuclear power plants in construction.

Basic Industry Metrics by Region (MWs, barrels per day)





Narrative

+ The dominance of the US in the upstream refining sector (installed capacity), and the growing significance of China is shown in the first illustration. It should be noted that while the US has the larger refinery base, the growth rate for new greenfield refinery capacity is much higher in China.

+ The dominance of Asia in electrical generating capacity (China, India, Japan, S. Korea) is shown in the second illustration. Asia also overwhelmingly dominates the rest of world in new greenfield electric power plant construction (both nuclear and coal-fired).

Key Industry Drivers for Valve Sales

Key Drivers for Valve Sales

Key Drivers

+ **Non-OECD Countries:** Population growth, urbanization, increased standard of living, increased energy demand

+ **OECD Countries:** Aftermarket sales, infrastructure re-build, technology upgrades

+ **Power Industry:** **New installed MWs** are a key driver for valve sales in power gen, and the market is overwhelmingly centered in Asia where new valve-intensive coal-fired and nuclear power plant construction is proceeding at a fast pace, particularly in China and India. The market in Japan could be substantial in the near future if the decision is made to permanently remove all 48 nuclear power plants from the grid. At this time, two nuclear power plants have been approved for re-start, but the fate of the other nuclear plants is still undecided.

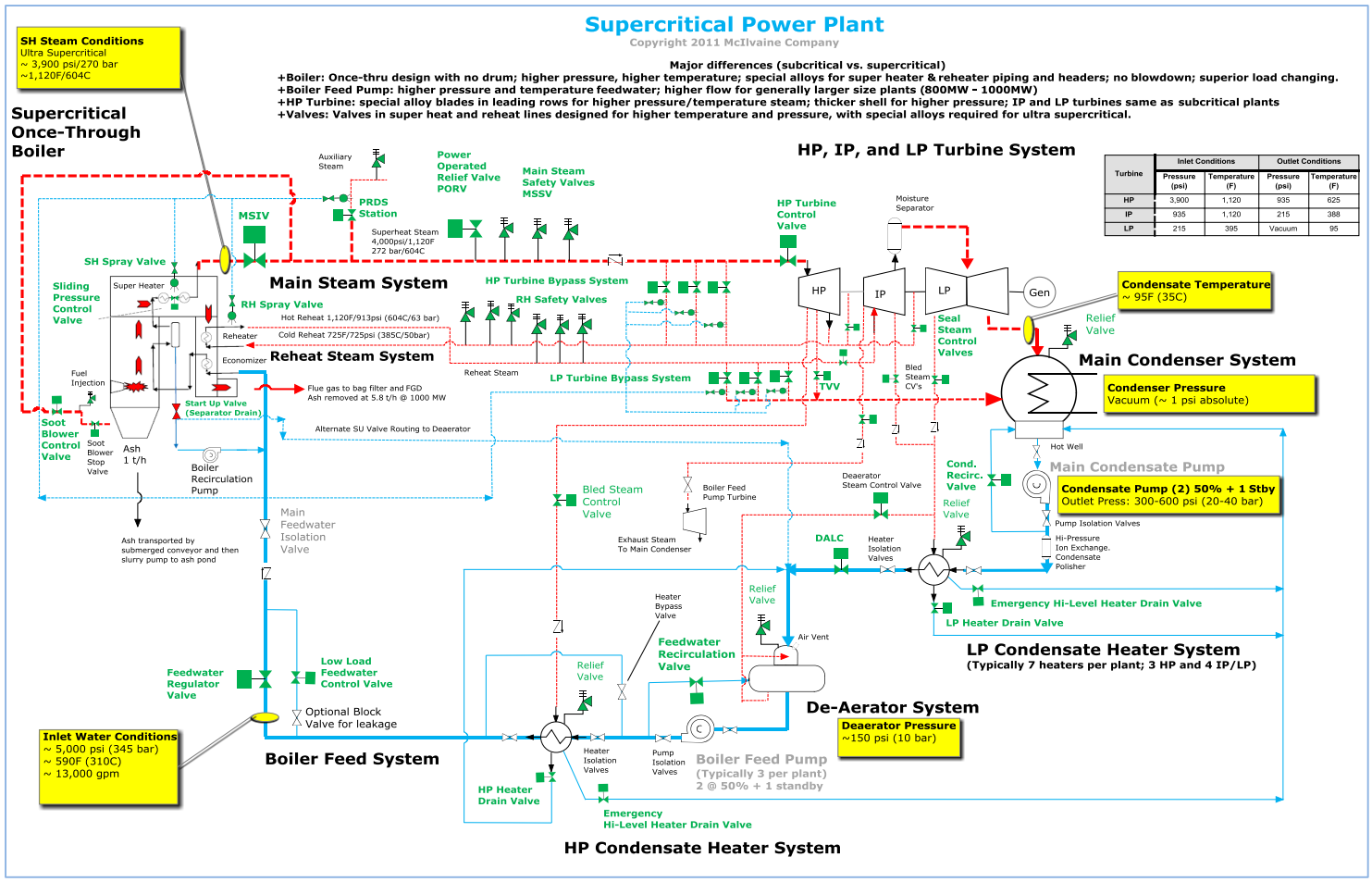
Load growth in western Europe and N. America is minimal at this time. However, **fleet restructuring** in N. America to replace coal with combined cycle gas turbine plants provides an attractive valve market.

+ **Oil & Gas/Refinery Industry:** **New barrels per day oil production** is a key driver for the oil & gas and refinery industries. As shown earlier, N. America has been experiencing a surge in production related to shale gas and oil. The N. American market has suffered a serious setback at this time due to the collapse in the price of oil, but is expected to recover slowly over the next several years. Refinery opportunities continue in Asia.

+ **Other Drivers:** Increased technological demands on valves, including special alloys for higher temperatures and pressures in supercritical power plants; improved seal performance for prevention of fugitive gas emissions in oil & gas markets; improved reliability for valves & actuators in deep subsea applications; to name a few.

Key Valve Applications and Market Sizing by Industry

Power



Key Valve Systems

+ Feedwater
+ Boiler
+ Main Steam
+ Condensate
+ Heater Drain
+ Cooling
+ Desuperheater

Key Valves

+ Control
+ On/Off
+ Safety relief
+ Isolation

Key Types

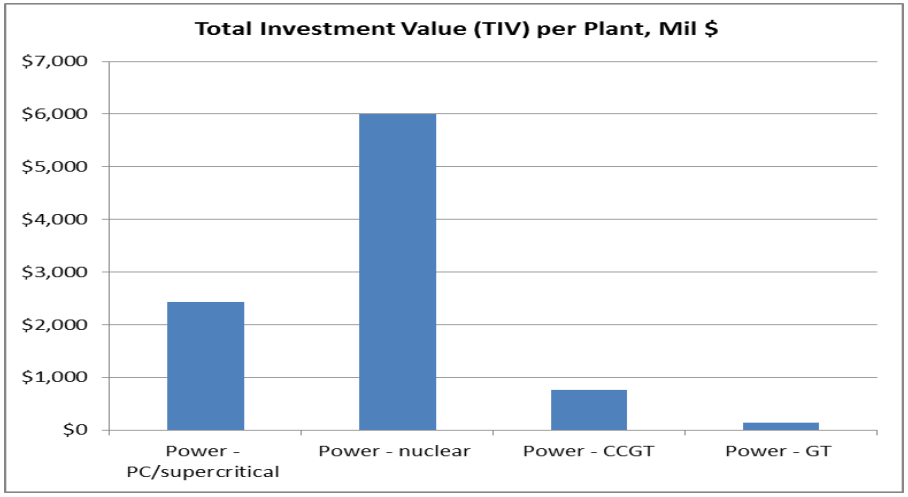
+ Gate
+ Globe
+ Ball
+ Butterfly
+ Check

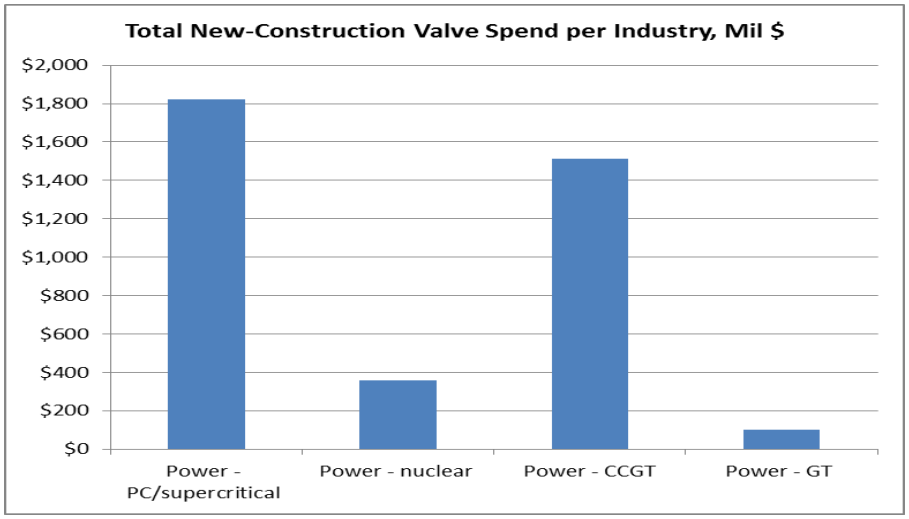
Narrative

+ A typical fossil-fired thermal power plant will have approximately $35-million in valves, with a nuclear plant at $50 to $80-million per plant. Major valve systems shown above for coal-fired plant.

Power

Market Sizing for New Construction





Market Sizing

- Approximate total investment cost (TIV) for coal-fired supercritical power plant is $2.5-billion per industry statistics. CCGT is substantially lower, and nuclear more than twice higher.
- Approximate valve spend per power plant is in the range of 1% to 1.5% of TIV, or $25-million to $35-million per plant (coal fired). Industry sources estimate $50-million to $80-million per plant for nuclear.
- If 50 new coal-fired plants are brought on line per year in China, the new-valve spend is over $1.5-billion in China, not including aftermarket valve sales. Local sourcing requirements may limit the opportunity for imported valves.

Power

Valves in Gas Turbine Power Plants in Germany (example)

Gas turbine plants in Germany – In operation

Replacement valve opportunities in both peaking and combined cycle plants.

- Fuel delivery and storage
- Air intake
- Combustion
- Generation
- HRSG
- Cooling tower or ACC
- Water treatment
- Wastewater treatment

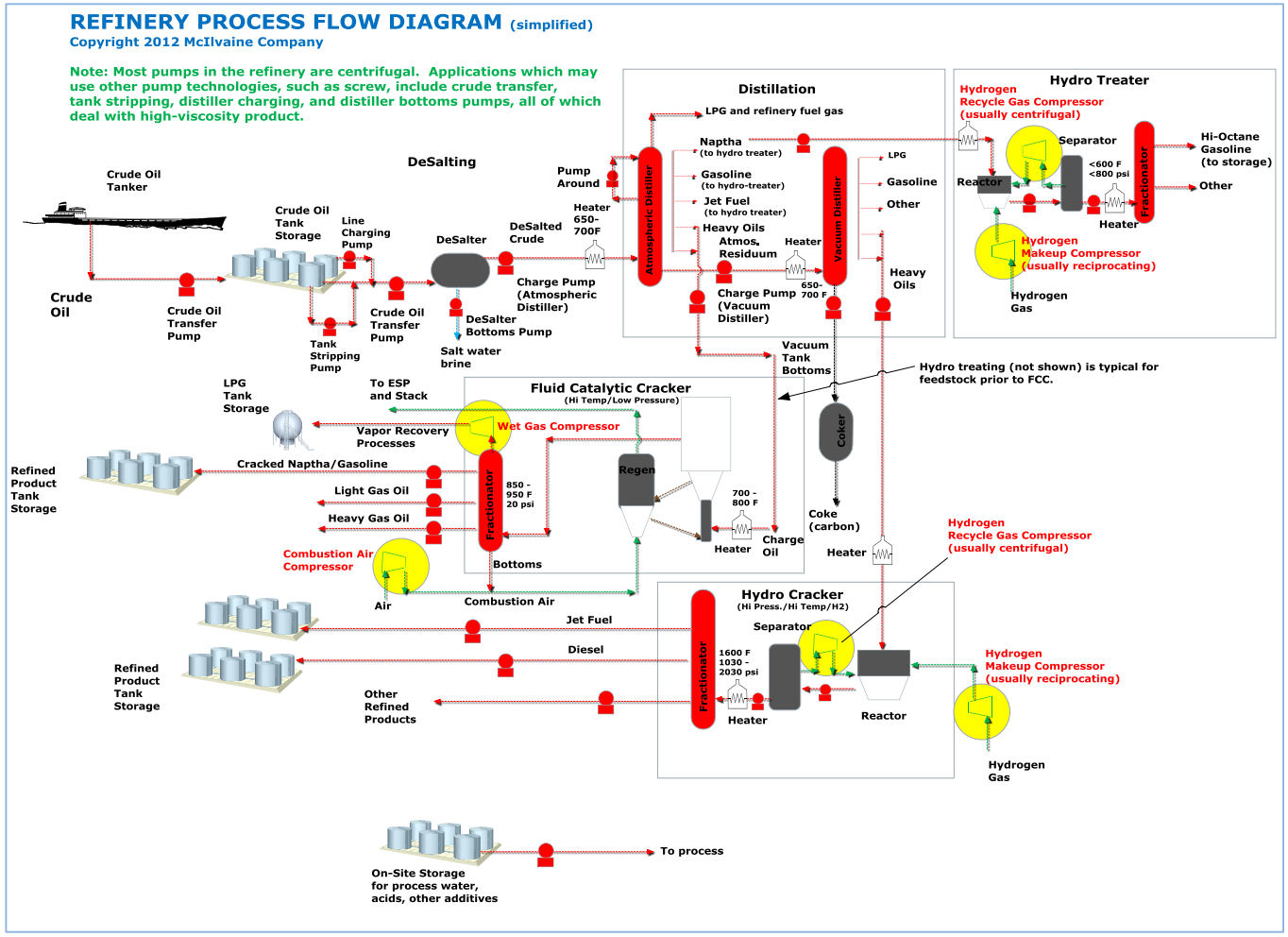
- Germany - Atel Holding Germany - DREWAG – Stadtwerke Dresden GmbH Germany - DREWAG Stadtwerke Dresden Germany - E.ON Kraftwerke GmbH Germany - E.ON Thuringer Energie Germany - EnBW Rhinehafen Germany - Gemeinschaftskraftwerke Irsching GmbH Germany - GEW RheinEnergie AG Germany - Infraserv GmbH & Co. Hochst KG Germany - Knapsack Power GmbH & Co KG Germany - Kraftwerk Mainz-Wiesbadan AG Germany - Kraftwerke Gera GmbH Germany - Mainova AG Germany - Mark E Energie Germany - Mark-E Germany - Mark-E AG Germany - MVV Energie Germany - NUON Energie und Service GmbH Germany - Papierfabrik Palm GmbH & Co KG Germany - RheinEnergie AG Germany - RWE AG Germany - RWE Generation Germany - RWE Generation SE Germany - RWE Power Germany - RWE Rheinbraun Germany - Siemens/E. ON Kraftwerke GmbH Germany - Solvay Chemicals Bielefeld Germany - Stadtwerke Bonn

Power

New Gas Turbine Power Plants in Germany (future builds)

Location Comment	Project Title	Startup Date
Baden Wurttemberg	Karlsruhe CHP CCGT - Trianel/MiRO Refinery	2020
Berlin	Klingenberg CHP CCGT - Vattenfall	2016
North Rhine Westphalia	Krefeld Uedingen CHP CCGT - Trianel	2019
North Rhine Westphalia	Lausward CCGT - Stadtwerke Dusseldorf	2018
North Rhine Westphalia	Leverkusen Chempark CCGT - Repower AG	2018
Berlin	Lichterfelde CHP CCGT - Vattenfall	2016
Hesse state	Ludwigsau CCGT - Dong Energy	On hold
North Rhine Westphalia	Niehl 3 CHP CCGT - RheinEnergie	2016
Brandenburg	Premnitz CCGT - Alpiq	On hold
Bavaria	UPM Schongau CHP CCGT - UPM	2015
Brandenburg state	Wustermark CCGT - Advanced Power AG	Cancelled

Refinery



Key Valve Systems

+ Atmos. Distiller
+ Vacuum Distiller
+ Hydro Treater
+ Hydro Cracker
+ Cat Cracker
+ Delayed Coker
+ Tank Fill/Drain
+ Anti-Surge Valves
+ Many others

Key Valves

+ Control
+ On/Off
+ Safety relief
+ Isolation

Key Types

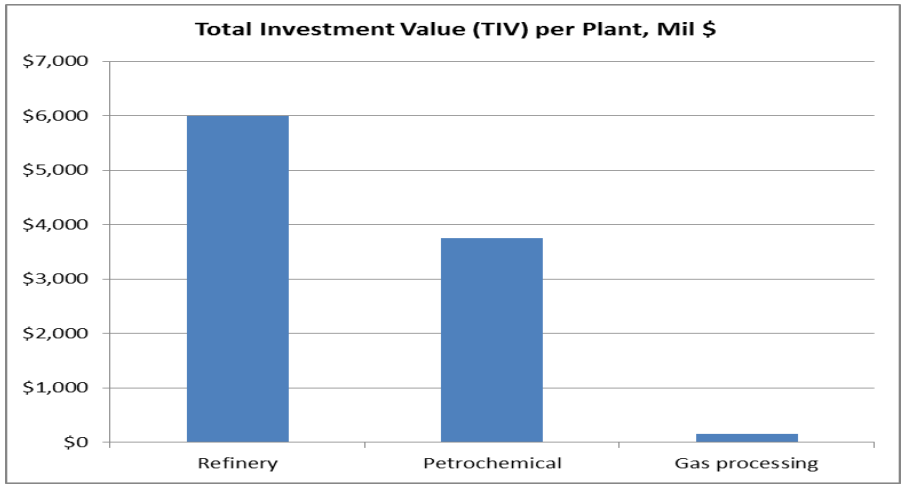
+ Gate
+ Globe
+ Ball
+ Plug
+ Butterfly
+ Check

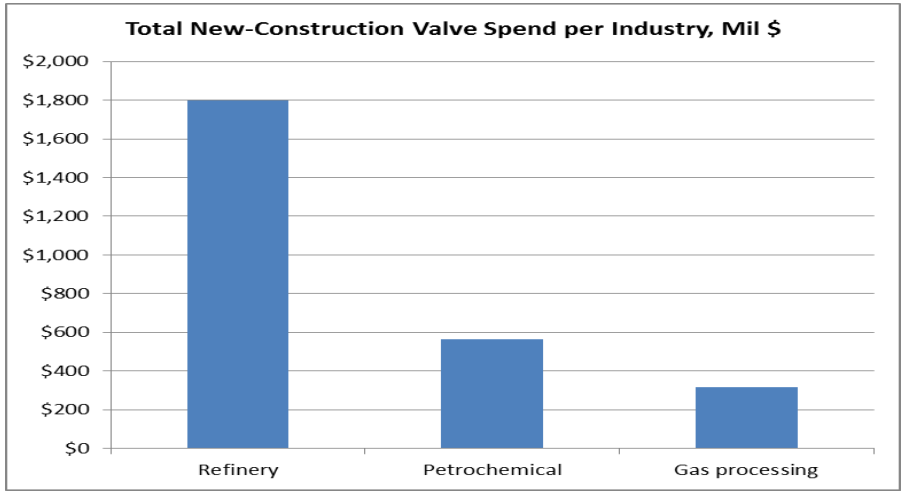
Narrative

+ There are approximately 650 refineries, worldwide. Total valve spend per refinery is approximately $120-million per plant, for new-plant construction. Total plant cost (new construction) is about $6-billion for a large refinery.

Refinery, Petrochemical, Gas Processing

Market Sizing for New Construction





Market Sizing

- Approximate total investment cost (TIV) for a new greenfield refinery is approximately $6-billion per industry statistics. Smaller field gas processing plants are more numerous but much lower cost.
- Approximate valve spend per refinery is in the range of 2% of TIV, or $120-million per plant.
- New greenfield refinery construction is focused primarily on the Middle East and Asia, with plant upgrades and capacity additions in the US. The total number of refineries (not capacity) in the US continues to decline due to closures of small inefficient plants

Project Costs (examples for refinery & petrochem)

Country	Industry	Location	Project Type	Total Project Cost, Mil $	Project Stage	Size	Contractor/EPC Name
Algeria	Refinery	Tiaret/Biskra/Ghardaia/Hassi	New	$6,000	Planning	300,000 bpd	Unknown (4 new refineries/planned)
Algeria	Refinery	East Algeria	Renovation	$2,000	Engineering	330,000 bpd	Samsung
Algeria	Refinery	Algiers	Expansion	$908	Engineering	72,000 bpd	Technip
Algeria	Petrochem	Arzew	New	$405	Construction	1.1 Mtpy	Total SA
Algeria	LNG	Arzew	New	$4,000	Engineering	4.7 Mtyp	Saipem, Chiyoda
Algeria	LNG	Skikda	New	$700	Construction	4.5 Mtpy	Lavalin, Black & Veatch
Algeria	Gas Plant	Algeria	New	$800	Engineering	177 MMcfd	Samsung
Algeria	Gas Plant	Adrar	New	$1,000	Engineering	4.5 bcm/yr	Technicas Reunidas
Algeria	Power Gen	Laghouat	New	$360	Construction	368 MW	GE (turbine); METKA (EPC)
Algeria	Power Gen	Biskra	New	$1,565	Construction	1600 MW	GE (turbine);
Algeria	Power Gen	Jijel	New	$1,565	Construction	1600 MW	GE (turbine); EPC: Daewoo, Hyundai
Algeria	Power Gen	Djelfa	New	$1,223	Construction	1250 MW	GE (turbine); Duro Felguera (EPC)
Algeria	Power Gen	Kais	New	$1,271	Construction	1300 MW	GE (turbine); EPC: GS, Daelin
Algeria	Power Gen	Montagenem	New	$1,418	Construction	1450 MW	GE (turbine); Samsung C&T (EPC)
Algeria	Power Gen	Naama	New	$1,137	Construction	1163 MW	GE (turbine); Samsung C&T (EPC)
Algeria	Power Gen	Oran	New	$435	Construction	445 MW	GE (turbine), Cegelec (EPC)
Algeria	Power Gen	Setif	Expansion	$1,200	Construction	1200 MW	Siemens (turbine); EPC: Daewoo,
Algeria	Power Gen	Oum El-Bouaghi	New	$264	Construction	264 MW	Ansaldo
Algeria	Power Gen	Lebreg	New	$264	Construction	264 MW	Ansaldo
Algeria	Power Gen	Ouragla	New	$660	Construction	660 MW	Ansaldo
Algeria	Power Gen	Biskra	New	$460	Construction	460 MW	Siemens (turbine); Hanwha (EPC)
Algeria	Power Gen	Boumerdes	New	$400	Construction	400 MW	Siemens (turbine); EPC: Daewoo
Algeria	Cement	Ain El Kebira	New	$357	Construction	2 Mtpy	ThyssenKrupp
Algeria	Cement	Bechar	New	$150	Planning	1.0Mtpy	Unknown
Algeria	Cement	Ain Salah	New	$75	Planning	0.5 Mtpy	Unknown
Algeria	Cement	Adrar	New	$300	Engineering	1.5 Mtpy	China Triumph Int'l Eng. Grp.(CTIEC)
Algeria	Cement	Djemora	New	$384	Construction	2.7 Mtpy	Unknown
Egypt	Refinery	Cairo	Expansion	$3,700	Construction	80,000 bpd	GS Engineering/Mitsui
Egypt	Refinery	Tahrir	New	$500	Construction	Unknown	GE & Carbon Holdings of Egypt
Egypt	Petrochem	Tahrir	New	$4,800	Construction	1.3 Mtpy	Foster Wheeler
Egypt	Petrochem	Alexandria	New	$400	Engineering	0.46 Mtpy	Toyo

Assessment Of Geographic Opportunities

Primary Industries	Comments
Refinery, gas plant, petrochemical	**Significant applications in North America, Middle East, North Africa, and China/India** particularly in refineries for FCCs and SRUs. Market reflects significant new-builds in the Middle East and Asia, and plant upgrades and expansions in North America.
Power	**Major opportunities in China, India, for new power plant constructions.** Also, significant opportunities for valves in FGD systems in the Middle East and China/India. Mature industry with limited opportunities in OECD countries, with the exception of CCGT plants in North America.

Review
Opportunities and Threats

OPPORTUNITIES

+ **Non-OECD Countries:** Population growth, urbanization, increased standard of living, increased energy demand
+ **OECD Countries:** Aftermarket sales, infrastructure re-build, technology upgrades, shale gas and oil
+ **Technology upgrades** to meet more severe service conditions for valves (subsea, power plants, etc)
+ **Increased system automation** driving actuator sales
+ **GHG legislation** requiring more stringent performance related to fugitive emissions

THREATS

+ **Local sourcing** requirements for equipment, becoming more common in Latin America, China, and parts of Africa
+ **Low oil price** that constrains entire oil & gas industry and associated equipment sales
+ **General weakening** of China economy
+ **Strength of US dollar** (threat for US suppliers exporting to international markets)

OVERALL

+ On balance, conditions look favorable for increased valve sales with economic and technological drivers outperforming market headwinds, given careful consideration of geographic markets