

Transition to sustainable fuels

Flow control solutions for biorefining





Sustainable fuels production

Biorefineries are processing facilities that convert bio (organic) feedstock into value-added products such as biofuels, biochemicals, bio-energy/bio-power and other biomaterials. Feedstock usually constitutes forestry waste, agricultural waste, lignocellulosic materials along-with plant-based starch, municipal solid waste, waste oils and gases.

Biorefining complexes incorporate a mix of emerging sustainable processing technologies, along-with the conventional ones for the production of sustainable derivatives.

Through decades of experience with flow control solutions for traditional process industries, Valmet has been able to adapt these to meet the demands these emerging biorefining technologies.

We support the conversion of bio-based waste materials into new value added products.



Insights into this sustainable sector

Globally, biorefining is gaining traction due to an increase in awareness about climate change, limitations over existing fossil resources, stringent environmental regulations and the significant revolution we're experiencing in the use of sustainable technologies.

One of the key potential market drivers has been biofuels, where-in Sustainable Aviation Fuel (SAF) and transportation fuels like green diesel are finding greater prominence due to growing market demands for alternatives to the fossil fuels.

Biorefining processes gaining ground due to commercial viability:

- **Hydrotreatment** (HVO, HEFA) with Used Cooking Oil (UCO), tallow, or vegetable oils as feedstock
- **Alcohol to Jet** using the ethanol infrastructure
- **Gasification & Fischer – Tropsch** (FT) with biomass residues, wood, or municipal solid waste (MSW) as feedstock
- **Pyrolysis** using biomass feedstock

Closer look at the emerging sustainable fuel process pathways

Hydroprocessed Esters and Fatty Acids (HEFA)

The HEFA process is a proven pathway for converting feedstocks like vegetable oils, waste oils, and fats into high-quality biofuels. The production process involves several key stages. First, the feedstock undergoes pre-treatment to remove impurities. This is followed by hydrogenation and deoxygenation, which saturates the feed with hydrogen and removes oxygen.

Next, isomerization and hydrocracking rearrange and break down the hydrocarbon molecules to create fuel properties equivalent to those of conventional fuels. Finally fractionation separates the mixture into finished products such as SAF, renewable diesel and naphtha.

The HEFA process is a proven pathway for converting feedstocks like vegetable oils into high-quality biofuels. Technology and configuration depend heavily on the feedstock used.

Alcohol-to-Jet (AtJ-SPK)

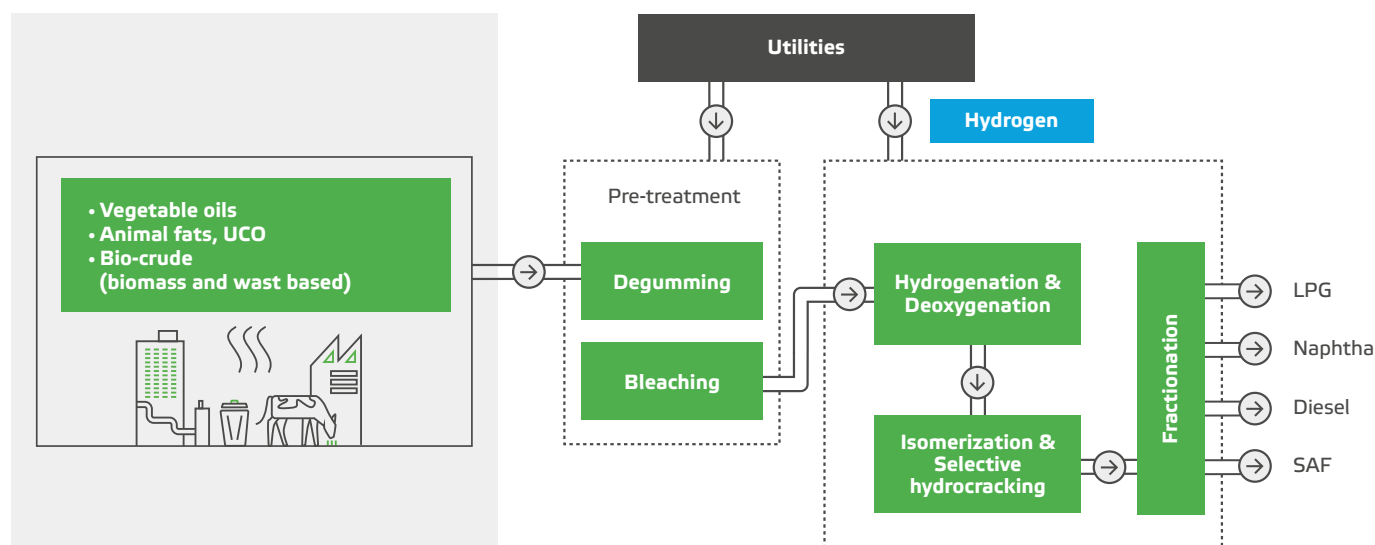
Alcohol-to-Jet Synthetic Paraffinic Kerosene (AtJ-SPK) is an approved pathway that uses catalytic conversion to turn alcohols, such as ethanol or isobutanol, into SAF and other useful fuels. The core stages of this process begin with a dehydration step that removes water from the alcohol to produce alkene molecules.

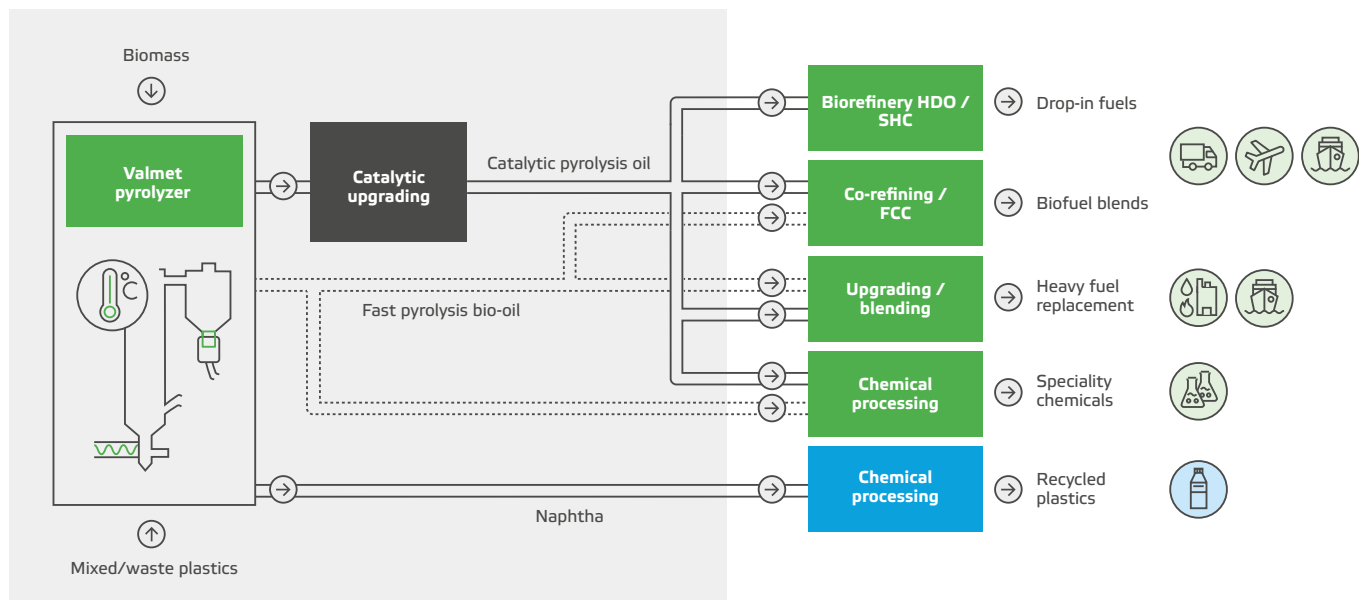
These molecules are then built up into longer chains of the desired length through oligomerization. The resulting molecules are stabilized through hydrotreating, which saturates the hydrocarbon chains. In the final fractionation stage, the product is separated into different fuel types, including SAF and diesel.

Gasification + Fisher Tropsch

This thermochemical route produces high-quality, low-carbon liquid fuels from a wide variety of feedstocks, including biomass, municipal solid waste, and even captured CO₂ combined with green hydrogen. The process begins with gasification, which heats the feedstock in a low-oxygen environment, breaking it down into a synthesis gas (syngas) composed mainly of carbon monoxide and hydrogen.

The syngas then undergoes conditioning to purify it for the next stage. In Fischer-Tropsch synthesis, the purified syngas is passed over a catalyst, which converts it into long-chain hydrocarbons. Finally, hydrocracking and distillation refine these hydrocarbons into drop-in fuels like synthetic diesel and jet fuel, which are compatible with existing infrastructure.





Pyrolysis is an effective pathway for converting biomass into renewable fuels and chemicals.

Pyrolysis of biomass

Pyrolysis is a process where organic materials, such as agricultural residues or wood waste, are heated in an oxygen-free environment. This causes them to decompose into more valuable products, offering an effective pathway for converting biomass into renewable fuels and chemicals.

The process yields three primary outputs: bio-oil, a liquid that can be upgraded into renewable fuels or used as a feedstock for chemicals; syngas, a combustible gas mixture that can be used for energy production; and biochar, a solid, carbon-rich material that can be used to improve soil quality and sequester carbon. This

flexible technology is central to the circular economy, transforming diverse waste streams into valuable resources while supporting decarbonization efforts.

Addressing process challenges

Valves in sustainable fuel production pathways face numerous challenges. We deliver robust and reliable flow control solutions engineered to overcome them.

Hydrogenation

- High pressure hydrogen gas
- Trace H₂S risks stress corrosion cracking
- Emission control of flammable gas for safety

De-oxygenation

- High temperature and moderately high pressures
- Tight sealing in fluctuating process conditions
- Catalyst abrasion and erosion

Drying

- Large thermal swings between ambient to high temperatures
- Adsorbent dust accumulation in cavities and sealing surfaces
- Bi-directional tight sealing

Hydrocracking and Isomerization

- Good rangeability compensating catalyst activity loss
- Minimize temperature variation
- Optimize hydrogen consumption

Process safety

- Compliance to ESD requirements
- Match de-pressuring system time and capacity
- Long-term idle reliability

Fractionation

- Column stability and separation efficiency
- Quick response and accurate control

Furnace – Burner management system

- Extremely high reliability
- Fast acting
- Long lasting tight shut-off



Sustainable solutions offered at every stage of the process

Hydrogen injection valves

Make up and recycled hydrogen is injected into the reactor at high pressure in presence of typical catalysts thereby saturating hydrocarbons and forming compounds with elements like sulfur, nitrogen etc

Valmet's Neles brand cage guided GB series globe valves helps in pressure balancing, maintains tight sealing of up to-class V, ensures safety of both operator and the environment through its certified low emission packing construction and has option for NACE certified material grades that mitigates the risk of stress corrosion cracking arising from presence of hydrogen sulfide.

Neles™ GB series globe valve with VD series actuator and smart NDX™ controller



Deoxygenation valves

After hydrogenation, oxygen must be removed. For deoxygenation most applied process is hydrodeoxygenation (HDO). In HDO, oxygen is removed as water using hydrogen and catalysts at 300–400 °C and 30–40 bar.

Valves must withstand high temperature and pressure, resist thermal expansion, and remain tight under fluctuating conditions. Slurry phase and catalyst carryover can cause erosion and abrasion. Valmet's Neles brand X series full bore metal-seated ball valves feature solids-proof seats to prevent catalyst buildup. Materials and coatings are optimized for pure hydrogen or catalyst handling under severe conditions. For precise control, Neles Finetrol or Neles GU/GB series globe valves ensure reliable and efficient deoxygenation.

Neles™ Finetrol series eccentric plug valve with QPX series actuator and smart NDX™ controller



Dryer sequencing valves

Dryers remove hydrogen sulphide and trace amounts of water formed through the catalyst regeneration process. Valves here must withstand fluctuations in temperature while maintaining tightness over years of operation

Valmet's Neles brand smart controlled X series metal-seated ball valves with scraping and closed seat design are extensively used in these applications. Optionally the L6 series triple offset butterfly valves with true metal seats protected from the shear force of the process fluid and mechanically induced tightness can also be a viable option. The valves are mounted with Neles field proven intelligent SG9000 series controller which is a single device that provides the functions of SOV, Open/close feedback, quick exhaust, fast actuation & throttling.

Neles™ X series ball valve with B1 series actuator and smart SwitchGuard™ controller



Neles™ L6 series butterfly valve with B1 series actuator and smart SwitchGuard™ SG9000 controller



Hydrogen quench control valves

Accurate control of hydrogen quench is essential to manage feed variations and maintain temperature equilibrium between bed inlet and outlet, minimizing catalyst deactivation and maximizing product selectivity.

Valmet's Neles brand GB series globe control valves with Tendril trims deliver precise control, cavitation and noise mitigation, and reduced process variability – optimizing hydrogen consumption while enhancing overall process performance.

Neles™ GU series globe valve with VD series actuator and smart NDX™ controller



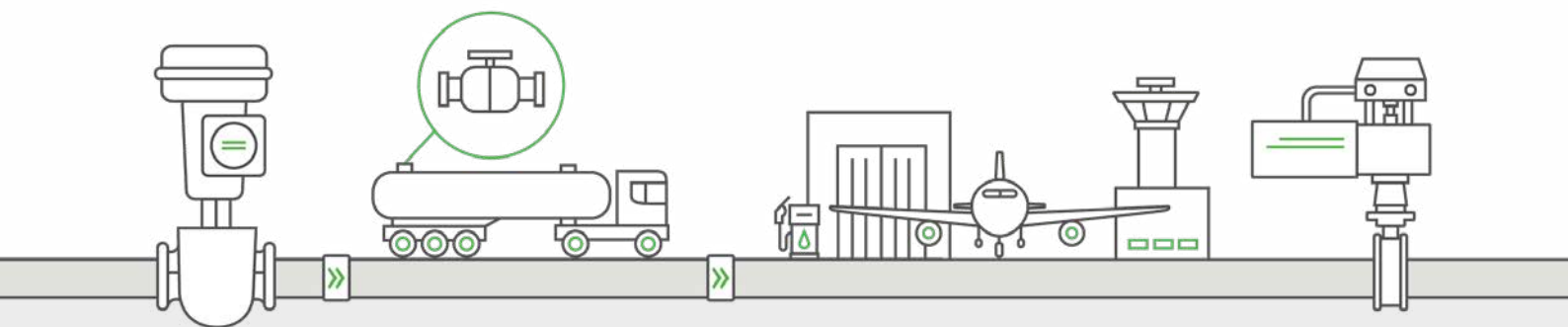
De-pressuring valves

De-pressuring systems form a critical layer of defense in the process industry against HSE risks arising from potential failures of process equipment's such as reactors due to fire or runaway reactions generating excessive heat.

Valmet's solution addresses both operational and emergency needs with the offering of Neles brand high-capacity metal-seated X-series ball valves, integrated with custom-designed Q-Trims for controlled media discharge. These trims helps in limiting outlet velocity while mitigating cavitation and noise, ensuring safe and efficient depressurization.



Neles™ X series ball valve with B1 series actuator and smart ValvGuard™ controller



Fractionator column control valves

Efficient stripping of the processed hydrocarbon fractions relies on synchronized operation between the reboiler and reflux drum. The reboiler regulates heat input to the column, while the reflux drum balances fraction separation and energy consumption.

Valmet offers Neles brand rotary segmented RE series control valves with wide rangeability and precise control, enhanced by smart diagnostic controllers for optimized performance.

Neles™ GB series globe valve with VD series actuator and smart NDX™ controller



Burner valves

Furnaces and heating systems must operate with precision to ensure the desired high quality of the end-product. Valves in the burner control systems of biorefinery's thermal processing units play a crucial role in ensuring safe, reliable and economical operation.

Valmet's certified safety shut-off valves (SSOV) from Jamesbury product line provide highest safety integrity in burner management with SIL3 and burner valve approvals fulfilling ISO, European and North American standards such as ISO23553-1, EN161, CSA, FM and AGA). Neles globe valves and Neles rotary control valves ensure precise and repeatable control, provide an optimal air-gas mixture, save energy and reduce emissions and costs.

Jamesbury™ polymer seated 7000 series ball valve with VPVL series actuator and Stonel™ feedback module





Delivering proven performance

Valmet is your reliable valve partner for the ever-growing sustainable energy industry. Our long experience and comprehensive portfolio covering the majority of industrial process applications.

Traditionally Valmet is known for delivering field proven valves and valve automation solutions across critical and demanding refining & petrochemical applications like catalyst handling, switching, emergency shut-down service, burner management systems etc. Looking

ahead, we continue to build on our legacy by driving innovation in smart, reliable, and sustainable flow control solutions to meet the future demands of sustainable process applications in the refining and petrochemical industries.



Portfolio for valve automation solutions



Neles NDX



Stonel Axiom



Neles heavy duty scotch yoke



Neles series B1



Neles SwitchGuard



Neles ValvGuard



QPX pneumatic actuator

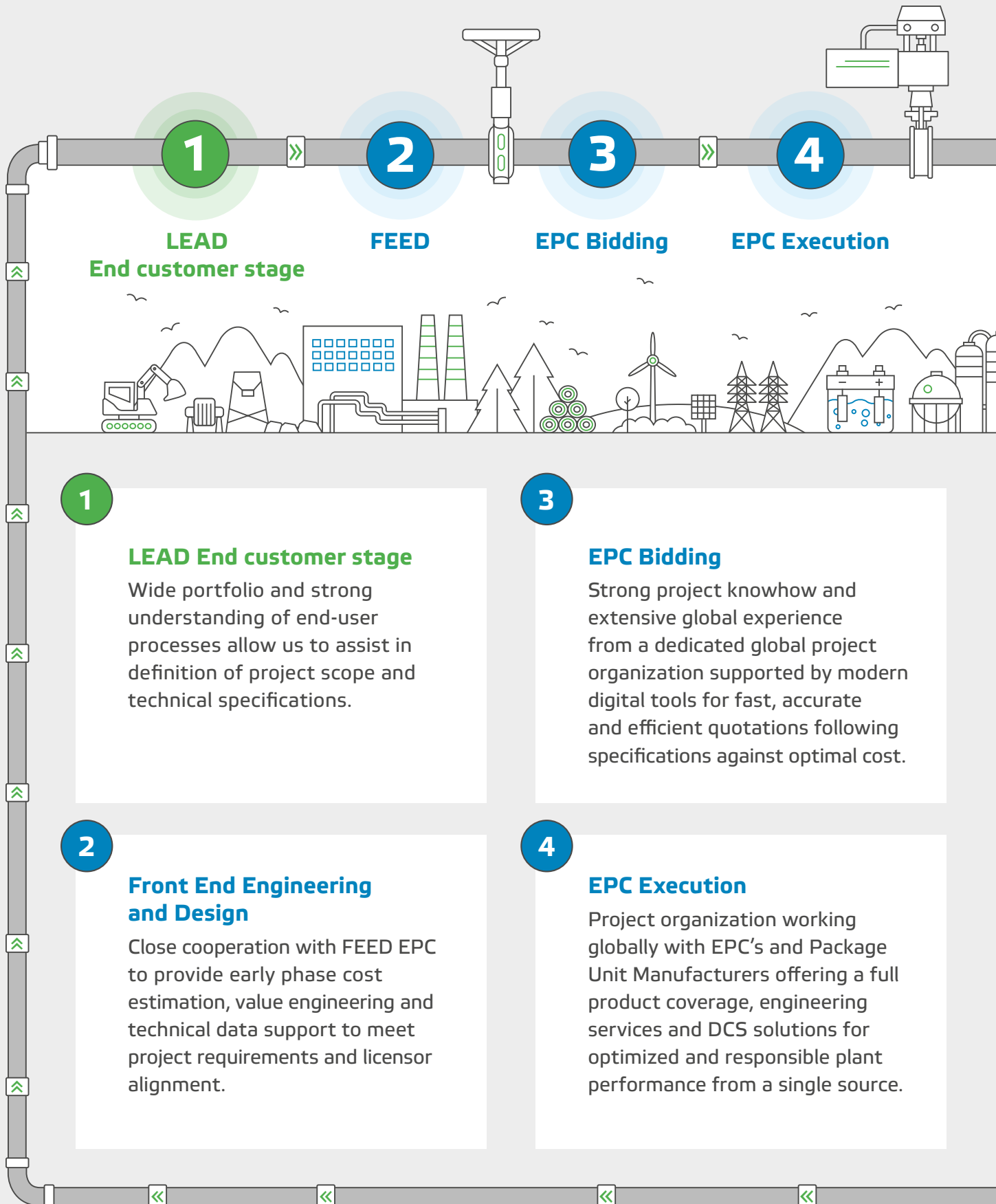


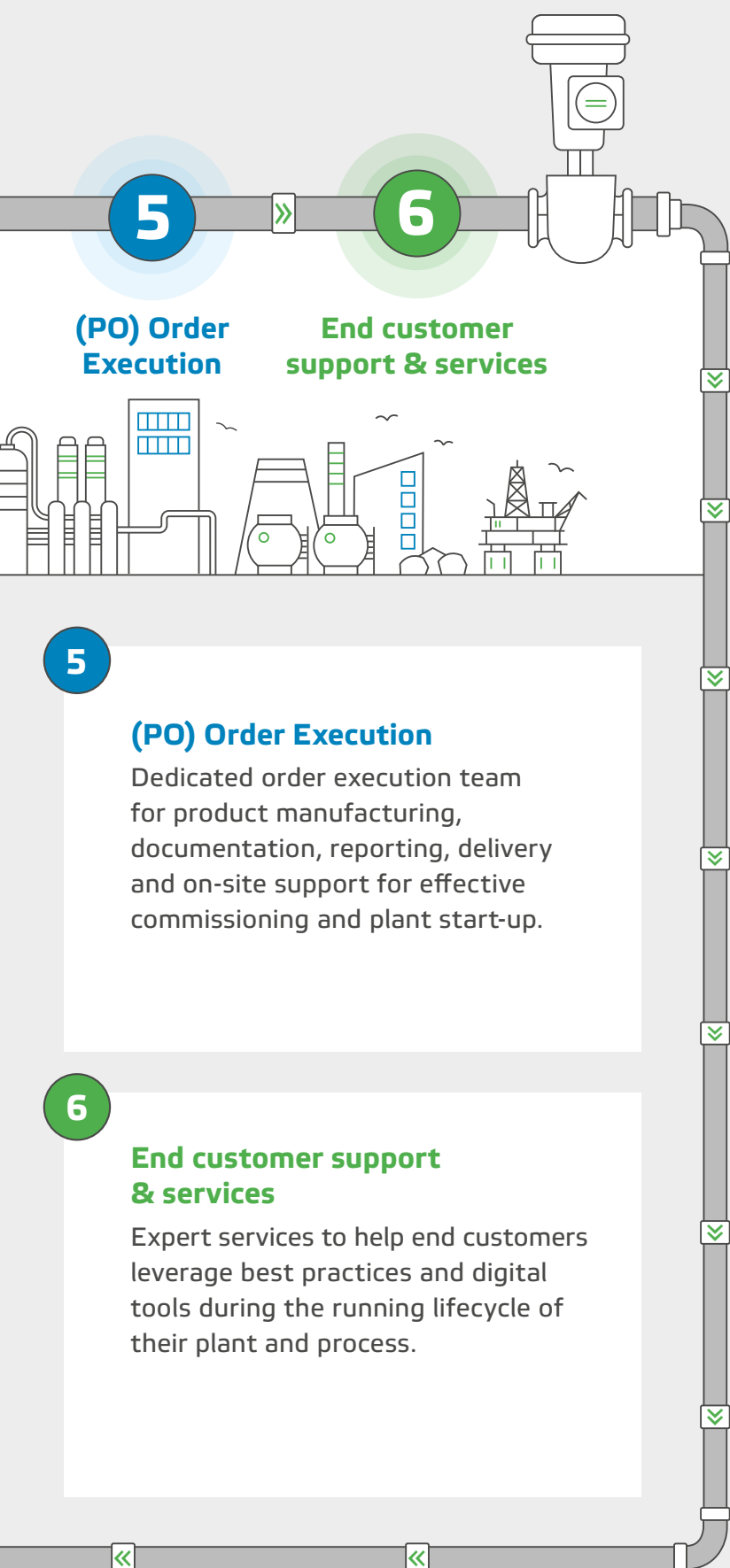
Valvcon electrical actuator

Valve controllers

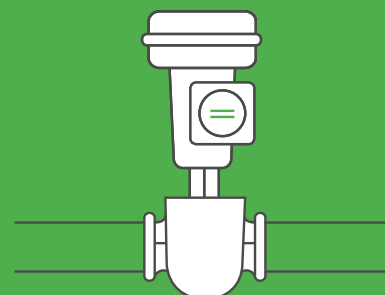
Actuators

Process industry EPC projects





Technologies and services for optimum performance



Reliable and accurate solutions for control, on/off and emergency shutdown applications from the industry's widest valve portfolio.



Easy, safe and reliable performance with solutions such as intelligent valve controllers, advanced diagnostics software and loop optimisation.



Comprehensive expert services and digital tools available globally, covering everything from commissioning and start-up to intelligent shutdown planning and lifecycle asset management.

Valmet is a global technology leader serving process industries. We work together with our customers throughout the entire lifecycle, delivering cutting-edge technologies and services as well as mission-critical automation and flow control solutions.



Valmet Flow Control Oy

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For more information, please visit
valmet.com/flowcontrol

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