



**DESIGN
ENVELOPE®**

**Intelligent Variable
Speed Pumps**

**with cloud-based
Active Performance
Management®**

SOLUTION OUTLINE



DESIGN ENVELOPE

ENGINEERED BEYOND THE OBVIOUS

Design Envelope technology is a demand-based, intelligent control solution that:

Models equipment and system behaviour

Monitors actual system conditions

Dynamically adjusts equipment operation to match system demand

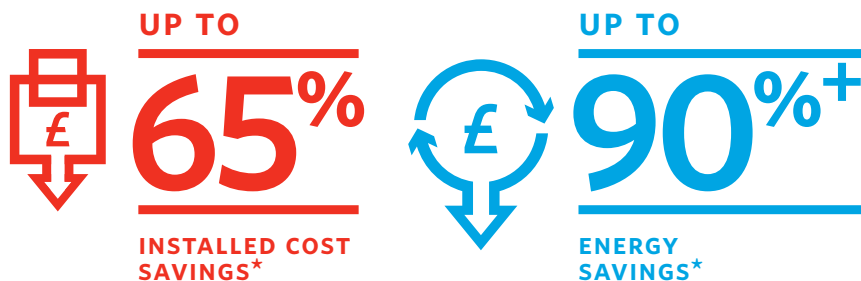


Whether driven by social, environmental or fiscal responsibility, forward-thinking organisations must embrace energy-saving technologies and practices.

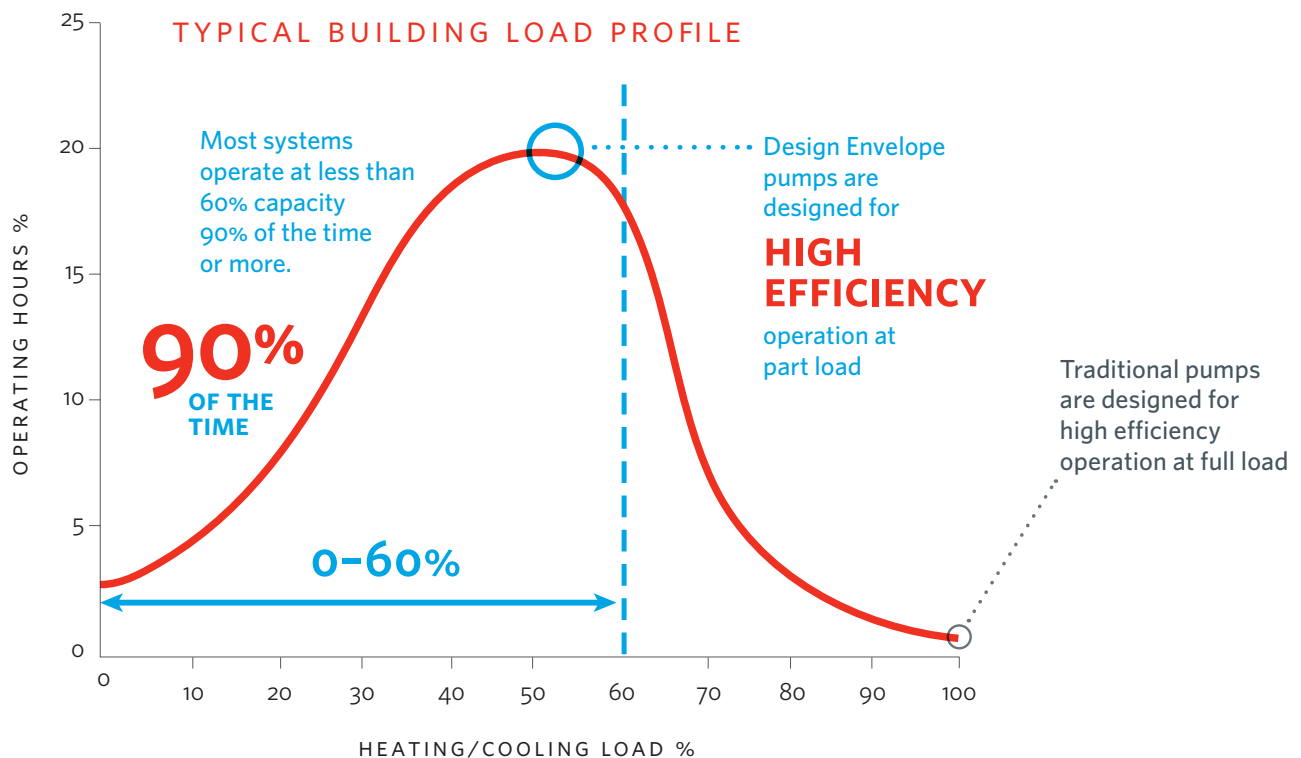


Armstrong Design Envelope pumps are a complete solution for heating, cooling and plumbing systems. The integration of a perfectly matched hydraulics, motive power and intelligent variable speed control creates the highest value pumping solution.

MAXIMUM ENERGY AND COST SAVINGS



- 1 Technology benefits
- 2 How it works
- 3 The solutions
- 4 Solutions range



Sizing and selecting for efficiency

Design Envelope solutions reduce pumping costs through variable speed, demand-based operation — consuming only the energy required, based on current system demand. Design Envelope pumps use a combination of optimised impeller size and speed control for energy efficient operation within a given performance envelope.

The performance envelopes are selected for the best pump efficiency where variable flow systems operate most often. This ensures a building's pumping system consumes as little energy as possible. It also helps to ensure that the installation meets or exceeds ASHRAE 90.1 guidelines requiring 70% energy savings at 50% of peak load.

*Compared to a fixed speed system

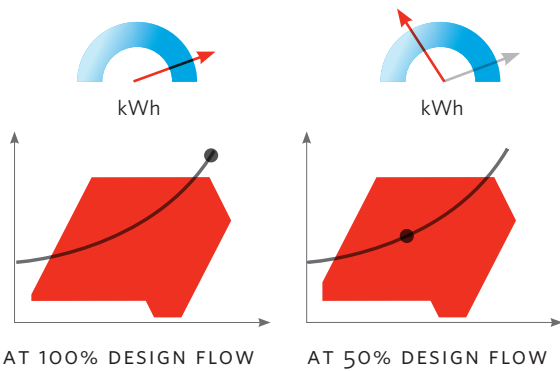
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THE TECHNOLOGY

THE EVOLUTION OF PUMPING

Energy Savings

Armstrong Design Envelope variable speed technology fundamentally changes the operation of a pump within the larger HVAC system. The variable speed intelligence embedded in the Armstrong Design Envelope controller adjusts the pump operation to meet the immediate demand. The pump responds instantaneously and draws only the power required to meet that demand.



Eliminate cost trade-offs

Through innovation, Armstrong's Design Envelope offers the lowest installed cost and lowest life cost of any pumping solution on the market.

CONSTANT SPEED PUMP 3-WAY VALVE

VARIABLE SPEED PUMP WITH CONTROLS DISABLED (PUMP IN HAND)

- > Constant speed operation
- > Base case for pump energy usage
- > Pump runs at design point, controlled by throttling

AVERAGE 15% ENERGY SAVINGS

VARIABLE SPEED PUMP WALL-MOUNTED CONTROLLER/2-WAY VALVE

- > Constant reduced speed
- > Reduce motor speed in lieu of throttling flow

UP TO 50% ENERGY SAVINGS

VARIABLE SPEED PUMP WALL-MOUNTED CONTROLLER/2-WAY VALVE

- > Sensor in mechanical room
- > Maintain constant design head
- > No savings if sensor stops working

UP TO 65% ENERGY SAVINGS

VARIABLE SPEED PUMP/ WALL-MOUNTED CONTROLLER/2-WAY VALVE

- > Inefficient induction motor operation
- > Pump selected to design point
- > Sensor located at remote load
- > Maintain pressure at remote zone
- > No savings if sensor stops working

UP TO 70%+ ENERGY SAVINGS

DESIGN ENVELOPE 3.1

- > Pump speed control through Sensorless technology
- > Detailed mapping of performance curve
- > Smaller motor selection on 25% of projects
- > Integrated controller — higher motor efficiency
- > Flow measurement accuracy of $\pm 5\%$
- > Optimised selection against load profile

PERFORMANCE OF CONSTANT SPEED PUMP 3-WAY VALVE



UP TO
80%+
ENERGY
SAVINGS

**DESIGN ENVELOPE
GENERATION 5**

- > Advanced digital controls
- > Control tuned to specific motor
- > DEPM motor: IE5 efficiency rating
- > Advanced hydraulics



UP TO
90%+
ENERGY
SAVINGS

**DESIGN ENVELOPE
GENERATION 5**

- > Multi-pump load sharing
- > Best-efficiency staging (Parallel Sensorless)
- > Onboard diagnostics and trending
- > Real-time performance management

**DESIGN ENVELOPE PERMANENT MAGNET (DEPM)
MOTOR BENEFITS (UP TO 7.5kW)**

- > Higher efficiencies at full load and part-loads for lower lifecycle costs
- > Higher stable operating speeds for smaller pumps, lower installed costs
- > Reduced noise and vibration for quiet and stable operation
- > Reduced weight and size for easier, faster installation
- > Less heat generated for longer equipment life

**NEXT
LEVEL
THINKING**

**ACTIVE
PERFORMANCE
MANAGEMENT
SERVICES
DELIVER:**

Ongoing tracking, analysis and benchmarking of HVAC performance

Deeper insights into HVAC operation for informed decision making

Data-driven optimisation in response to system changes

Long-term mechanical system efficiency

Overall savings in HVAC energy and equipment maintenance costs

THE RESULTS

ENERGY SAVINGS UP TO

90%+



HIGHEST ENERGY EFFICIENCY

1

Armstrong Design Envelope Pumps provide you with highest energy efficiency.



LOWEST INSTALLED COST

2

Design Envelope Pumps provide lowest installed equipment cost, plus savings in infrastructure such as transformers, switch gear, power cables, concrete and cabling.



LOWEST OPERATING COST

3

Design Envelope Pumps provide lowest operating and maintenance cost.

CASE STUDY | National Grid

ANNUAL ENERGY SAVINGS



70%

Armstrong recently completed a project in the United Kingdom, retrofitting pumps in a commercial office building belonging to National Grid. The retrofit included new pump sets that reduced energy consumption by 70%, saving over \$37,065 annually.

ANNUAL ENERGY COST

BEFORE AFTER

\$53,198

\$16,136

AUD

AUD

AVERAGE

AVERAGE

ANNUAL COST SAVINGS

\$37,065 AUD

CO₂ EMISSIONS

BEFORE

AFTER

82,309

24,967

kg CO₂

kg CO₂

AVERAGE

AVERAGE

ANNUAL CO₂ EMISSION REDUCTION

57,342 kg CO₂



FACILITY TYPE
Commerical office



LOCATION
Solihull, Birmingham



SIZE
Three-storey building



4

Design Envelope Pumps provide buildings with the lowest carbon footprint.

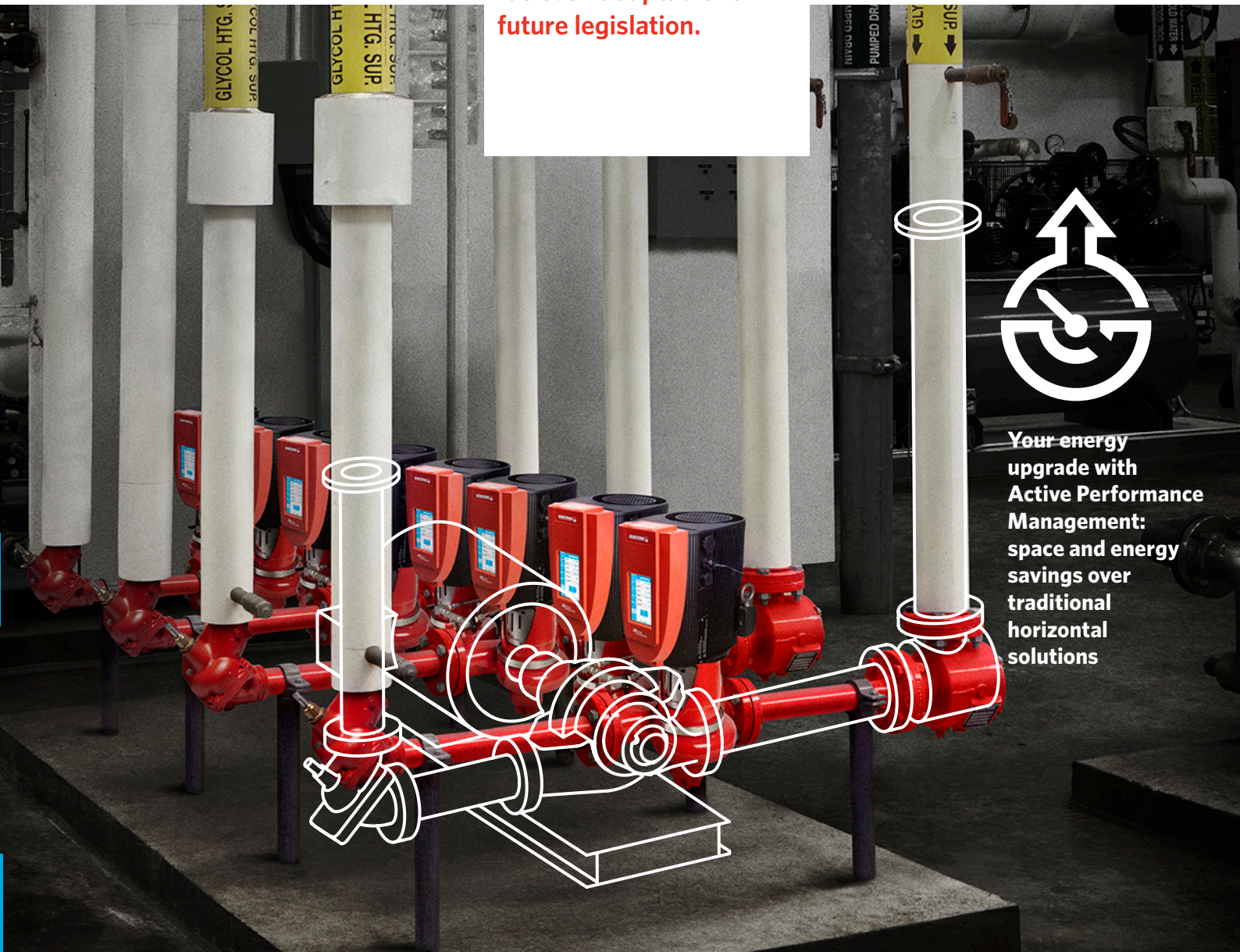


5

Design Envelope Pumps provide lowest project and operating risk, with solutions adaptable to design and building changes. It's even adaptable for future legislation.



Together, these five key benefits of Design Envelope technology provide customer value far beyond alternative variable-speed or constant-speed solutions.



Your energy upgrade with Active Performance Management: space and energy savings over traditional horizontal solutions

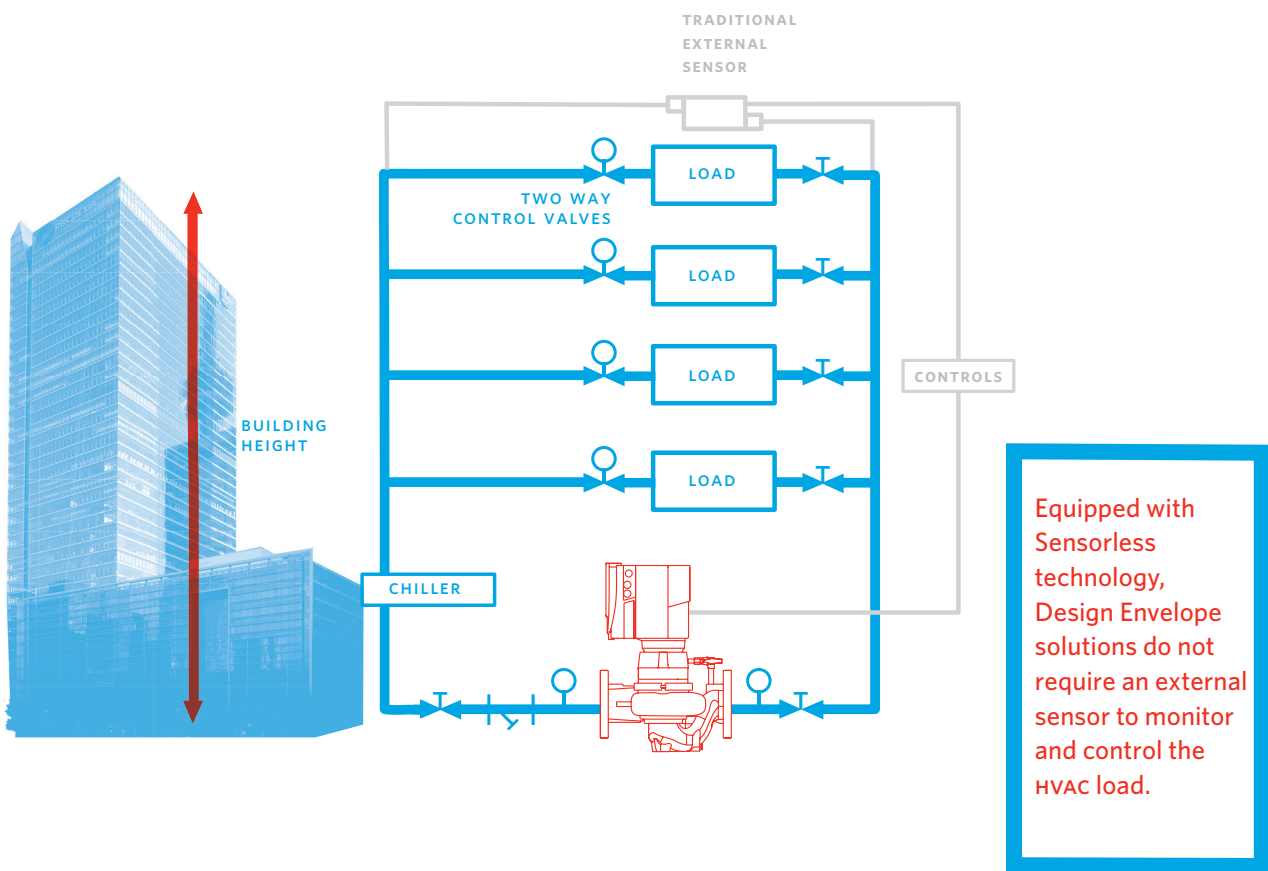
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HOW IT WORKS

SENSORLESS TECHNOLOGY



THE SENSOR WITHIN



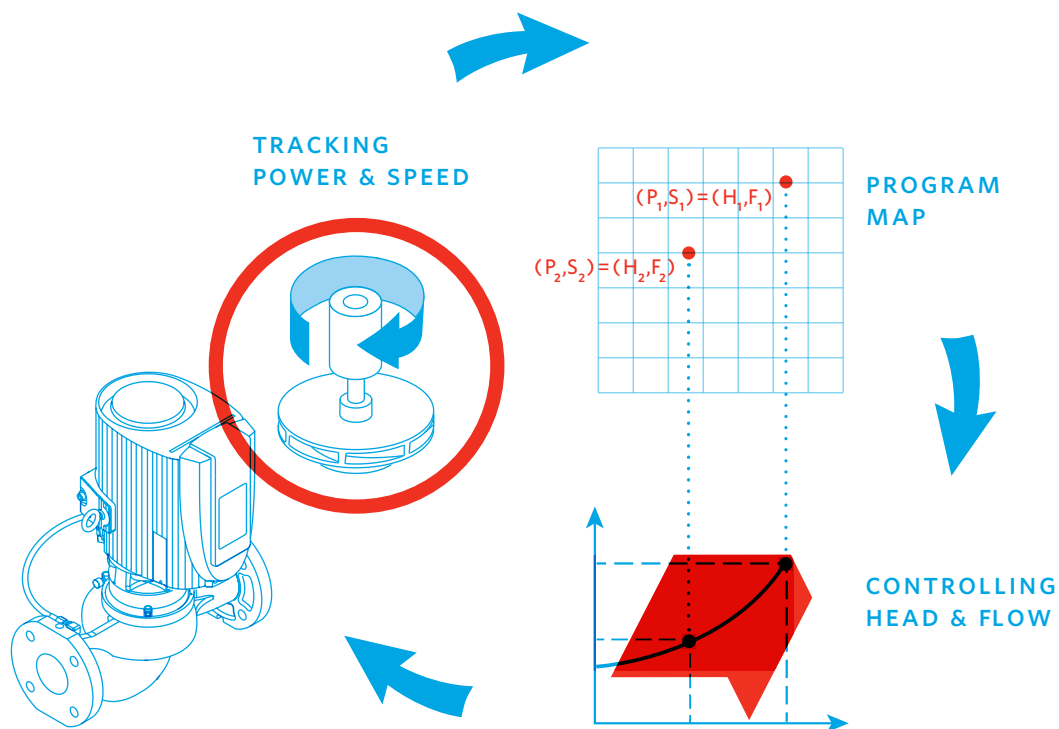
Using Sensorless technology, a Design Envelope pump's performance data (power draw and RPM) and operating curve are pre-programmed into the controller. During operation, the controller monitors the power draw and RPM of the pump and establishes the hydraulic performance and position of the pump's head-flow condition relative to the system requirements.

As the building's control valves open or close to regulate flow to the cooling coils and maintain building occupant comfort, the Sensorless controller automatically adjusts the pump speed to match the required system pressure and flow.



MONITOR POWER & SPEED

CONTROL HEAD & FLOW



Equipped with Sensorless technology, Design Envelope solutions do not require an external sensor to monitor and control the HVAC load.

In a chilled water system, a building's temperature controls influence the local flow of control valves that modulate the flow to the cooling coils (load). As the control valves open for more chilled water flow, the differential pressure across the valve decreases.

The controller reacts to this change by increasing the pump speed. If the control valves close to reduce the chilled water flow, the differential pressure across the valve increases and the controller reduces the pump speed.

PARALLEL SENSORLESS

SAVE UP TO **30%**

ON OPERATING COSTS

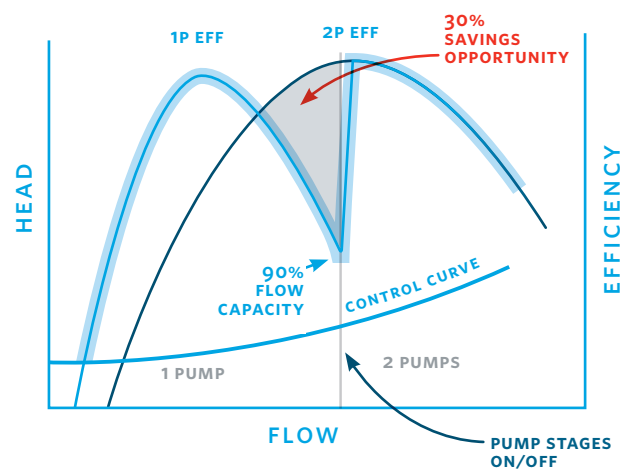
Parallel Sensorless Pump Control (PSPC) is a patented technology that improves the efficiency of a multi-pump installation through optimised load sharing.

The traditional approach to control in a multi-pump installation involves staging pumps on the basis of motor speed. Parallel Sensorless Pump Control technology stages pumps based on operating efficiency rather than motor speed and improves the efficiency of the full pump array by up to 30% over traditional multi-pump installations.

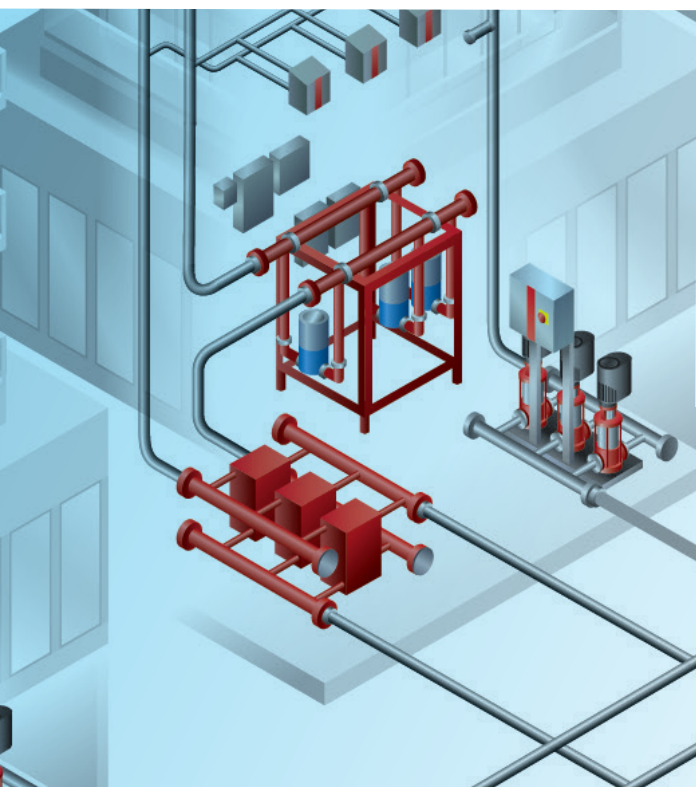
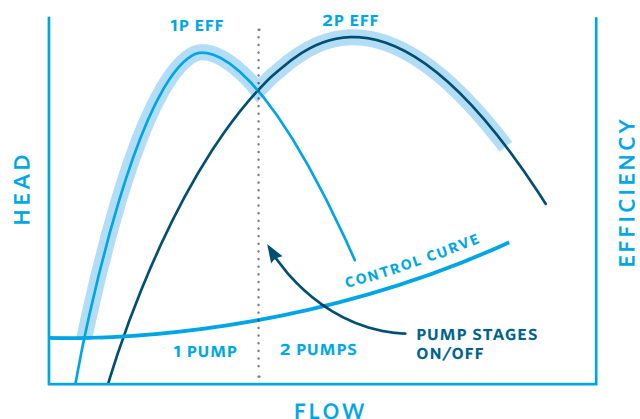
HVAC loads and flow requirements change throughout the day. In the graphs to the right, the grey dotted line intersecting the pump efficiency curves represents the flow level at which one pump in the array should be staged on or off. The solid grey line, however, indicates where staging often occurs with speed-based control, which forces the pump array to operate at efficiency levels that are less than optimal.

In an installation of (up to four pumps) Parallel Sensorless Pump Control monitors pump speed and stages pumps at the correct flow levels to optimise efficiency, as shown in the bottom-right graph.

TRADITIONAL SPEED-BASED STAGING



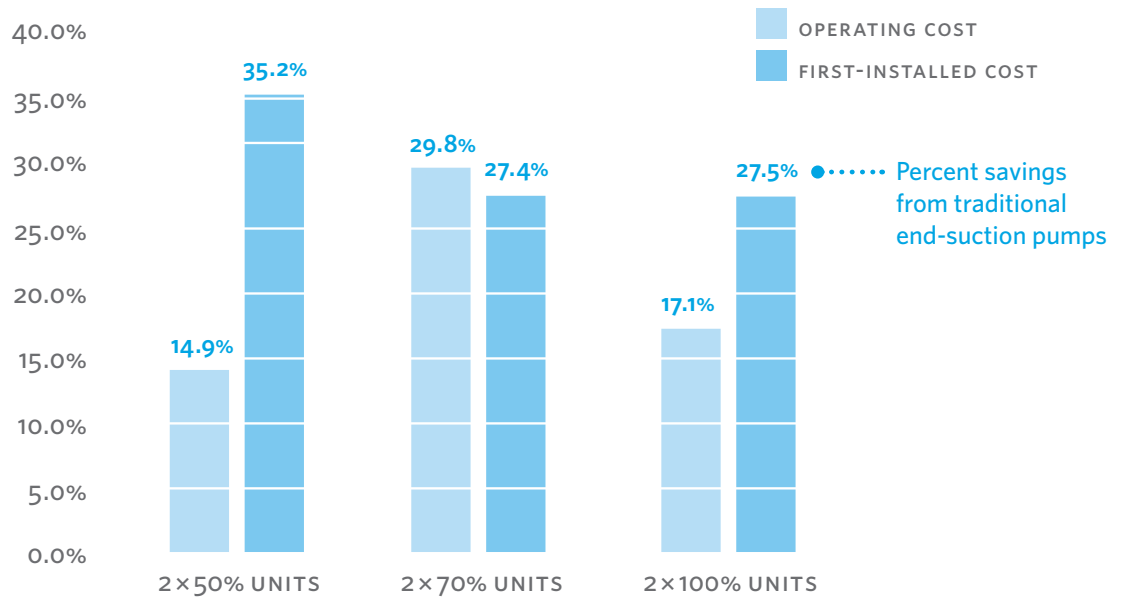
PARALLEL SENSORLESS PUMP CONTROL BEST-EFFICIENCY STAGING



Because HVAC pumping systems mostly operate at part-load, a design using two or more smaller pumps is more efficient than one larger pump. In a two-pump system, if one pump fails, the remaining pump can serve the system

requirements with up to 70% flow redundancy. The capacity split can be adjusted based on the building type and duty requirement.

REDUNDANCY AND SAVINGS WITH PARALLEL PUMPING



Parallel Pumping Configurations and Typical Building Examples

CAPACITY SPLIT	FLOW REDUNDANCY	DUTY REQUIREMENT	TYPICAL BUILDING EXAMPLES
Two pumps running at 50%	If one pump fails, the other will operate at 70%	Generic duty	Schools Apartments
Two pumps running at 70%	If one pump fails, the other will operate at 85%	High comfort sensitivity	Hotels Offices Outpatient clinics
Two pumps running at 100%	If one pump fails, the other will operate at 100%	Mission critical	Blood banks Hospitals Data centers

FLOW INFORMS

The rate of fluid flow in an HVAC system is crucial to understanding how the different components are operating. Without information on system flow, it's difficult to diagnose and optimise performance. With accurate flow information, the picture changes entirely. Armstrong can optimise each component and the overall system.

Design Envelope Pumps monitor flow so accurately they function as a flow meter. Industry standards recommend balancing system flows to $\pm 5\%$ accuracy. Design Envelope pumps deliver accuracy of $\pm 5\%$.

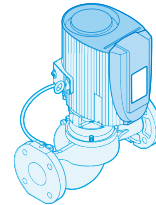
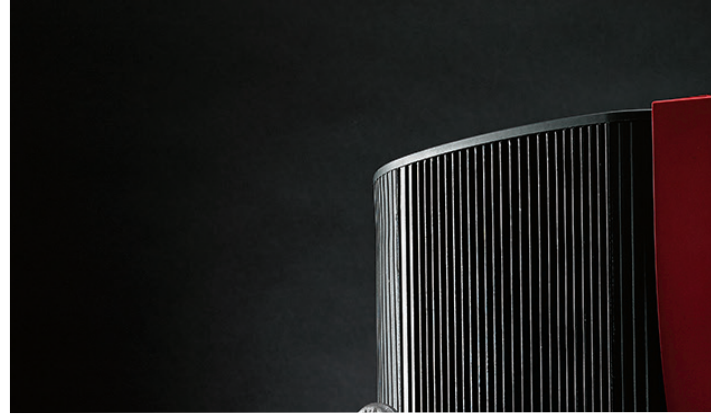
Highly accurate and reliable: no issues with fouling, so no need to service or re-calibrate.

Low installation cost: easy installation for retrofits.

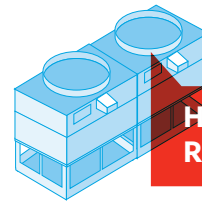
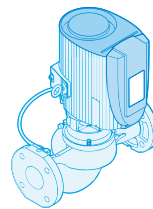
Integral to pump: no additional space or wiring required.

Energy savings: accurate flow data informs optimisation of an entire HVAC system.

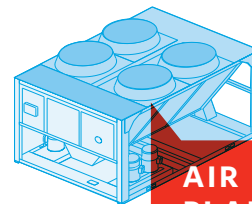
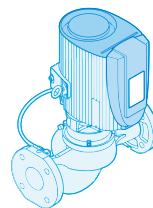
For evaluating an HVAC system, just two flow values and four temperature points provides all the data needed to understand flow rates, heat loads and operating efficiency.



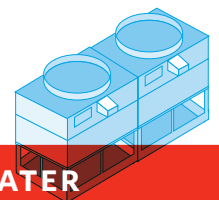
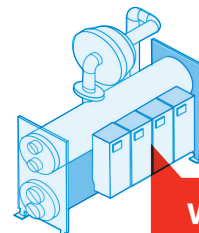
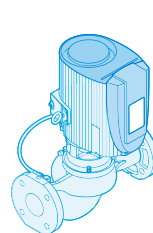
PUMPING SYSTEMS



HEAT REJECTION



AIR COOLED PLANT



WATER COOLED PLANT

$\pm 5\%$

FLOW MEASUREMENT ACCURACY

ARMSTRONG 

Flow **34.70 l/s**





ACTIVE PERFORMANCE MANAGEMENT™

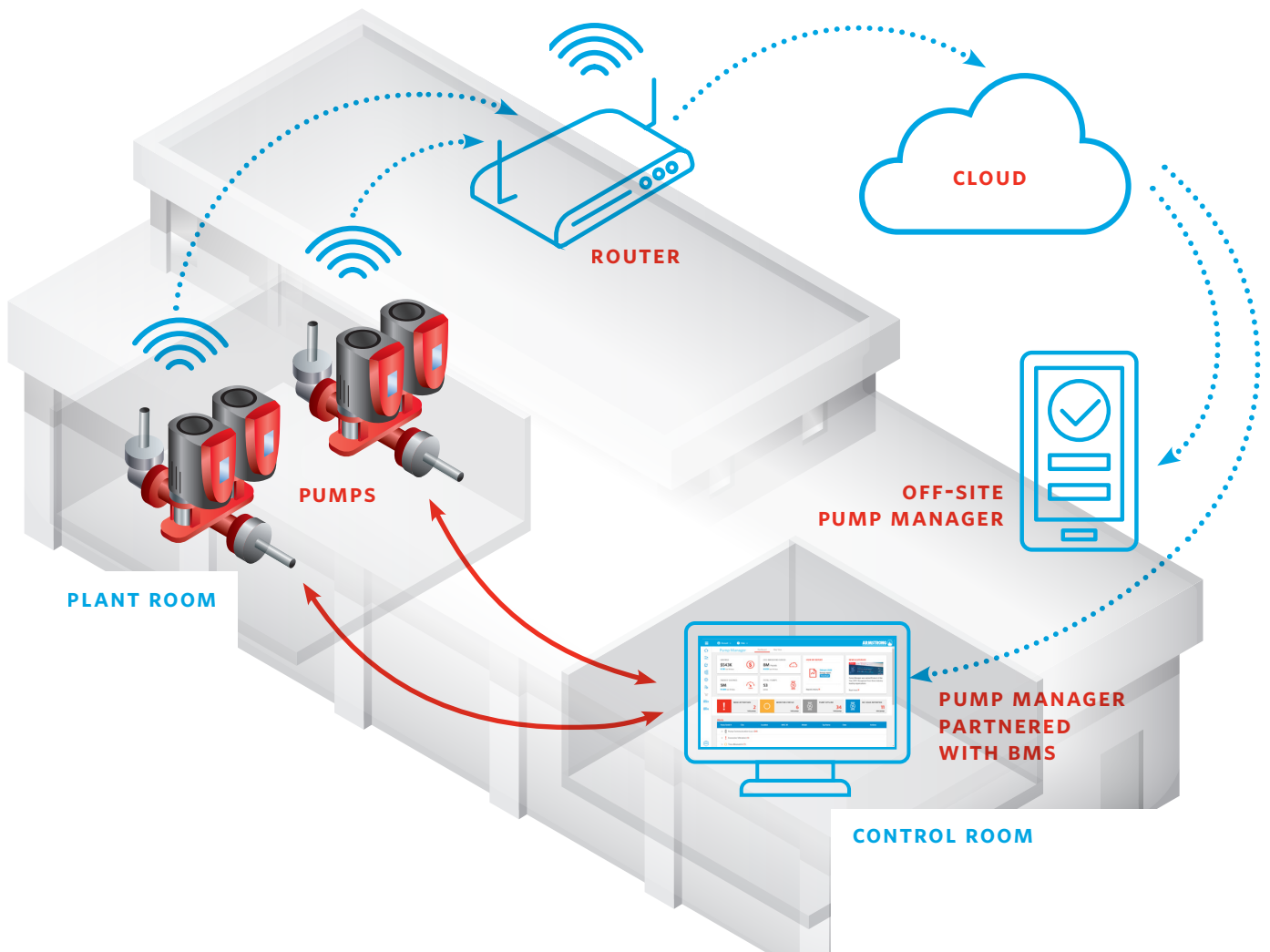
Active Performance Management is a systems management approach that optimises HVAC systems at any stage of a building's life-cycle by continually learning from a broad network of installations and responding to changing HVAC requirements.

The combination of smart commissioning with real-time alerts and system transparency addresses performance drift and maintains occupant comfort.

Bring performance drift under control

With Active Performance Management at the plant level, you can save up to

40% Annual cost savings



3

THE SOLUTION

VERTICAL IN-LINE PUMPS (VIL)

DESIGN
ENVELOPE

TECHNOLOGY



Available for outdoor
operation

For a 7.5 kW pump, save \$2,470
with pipe mounting and no
inertia base

THE HEART OF YOUR BUILDING

Mechanical room space savings

Pumps require minimal floor space or can be installed overhead

Reduced vibration

Dynamically balanced impeller and shaft assembly operates with minimum vibration

Lowest installed cost

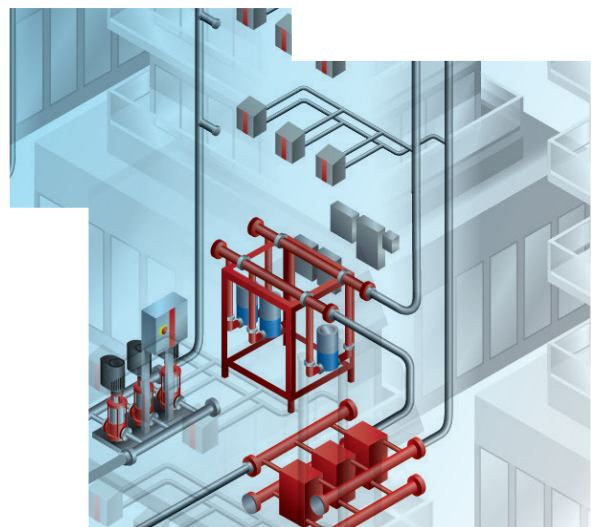
Component, Material and Labour savings — fewer fittings and no inertia base required

Reliability

Vertical In-Line design requires less maintenance, at a lower cost, than any other pump configuration

Easy maintenance

15 minutes to replace the mechanical seal — no need for realignment.



FOR ALL DESIGN ENVELOPE SOLUTIONS

Advanced performance control

Armstrong has reinvented and redesigned pumping solutions to include connectivity and performance management services. Design Envelope Pumps provide optimal lifetime efficiency through:

Expanded performance range (and options)

One-touch auto-flow balancing

Pump speed modulation based on an adjustable quadratic control curve for better part-load efficiency

Flow monitoring accuracy (+/- 5%)

Operating data and notifications to support diagnostics and service

Advanced onboard control functions

PERFORMANCE PACKAGES

FUNCTIONS INCLUDED



Sensorless Bundle (standard)

- Sensorless control
- Flow meter
- Constant flow
- Constant pressure



Parallel Sensorless (standard on Tango and dualArm)

- Parallel Sensorless control



Energy Performance Bundle

- Auto-flow balancing
- Maximum flow control



Protection Bundle

- Minimum flow control
- Bypass valve control



Zone optimisation

- Accept up to two dP sensor control signals



Dual-season setup

- Pre-set heating and cooling parameters for two-pipe systems

CASE STUDY | Carlson Court

ANNUAL ENERGY SAVINGS



87%

Armstrong replaced six constant speed pumps with new Vertical In-Line pumps. Combining Design Envelope technology and Pump Manager, Armstrong optimised pump operations for annual energy savings of 87%.



FACILITY TYPE
Large Office Complex



LOCATION
Toronto, Canada



SIZE
300,000 ft²

ANNUAL ENERGY COST



BEFORE

AFTER

\$160,460

\$21,452

AUD

AUD

AVERAGE

AVERAGE

ANNUAL COST SAVINGS

\$142,028 AUD

CO₂ EMISSIONS



BEFORE

AFTER

150,847

19,794

kg CO₂

kg CO₂

AVERAGE

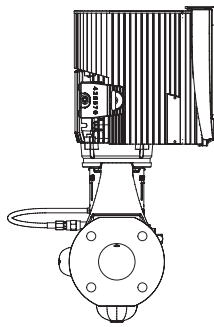
AVERAGE

ANNUAL CO₂ EMISSION REDUCTION

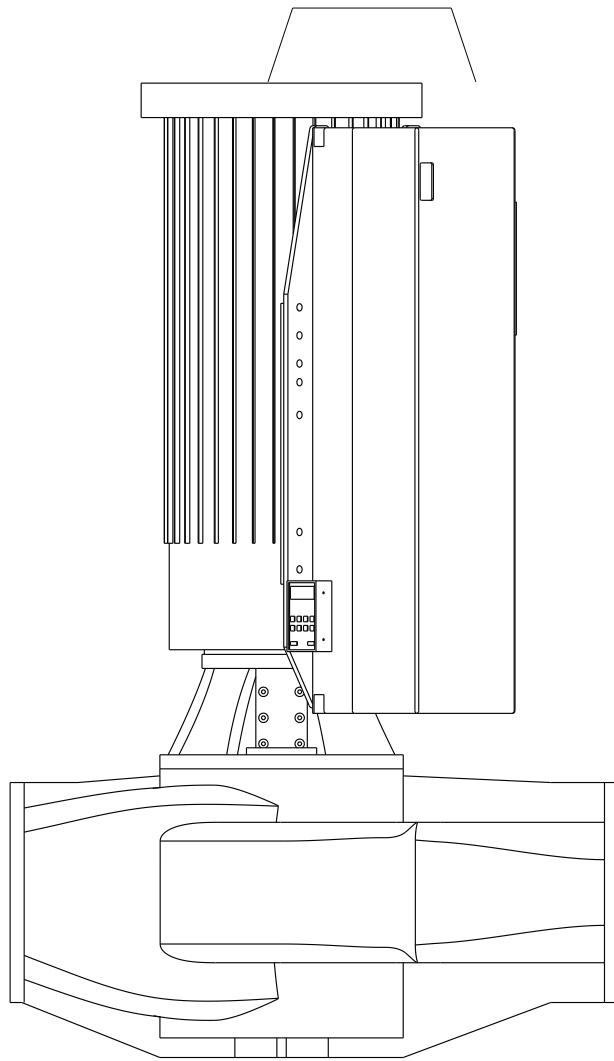
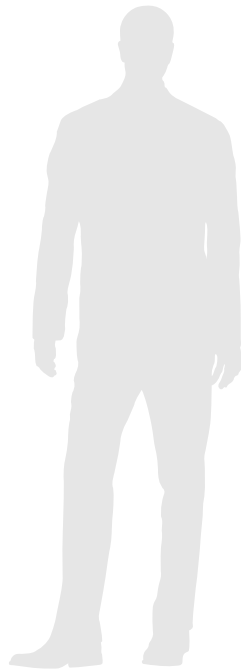
131,053 kg CO₂



THE QUEEN'S AWARDS
FOR ENTERPRISE:
SUSTAINABLE
DEVELOPMENT
2021



0.25 kW



Up to 932 kW available

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