ARMSTRONG

DESIGN ENVELOPE®

Intelligent Pumps

with cloud-based Active Performance Management®

SOLUTION OUTLINE

FILE NO: 100.111UK
DATE: NOVEMBER 2024

SUPERSEDES: 100.111UK
DATE: AUGUST 2024

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 organizations must embrace energy-saving technologies and practices on their path to Net Zero.

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 control creates the highest value pumping solution.

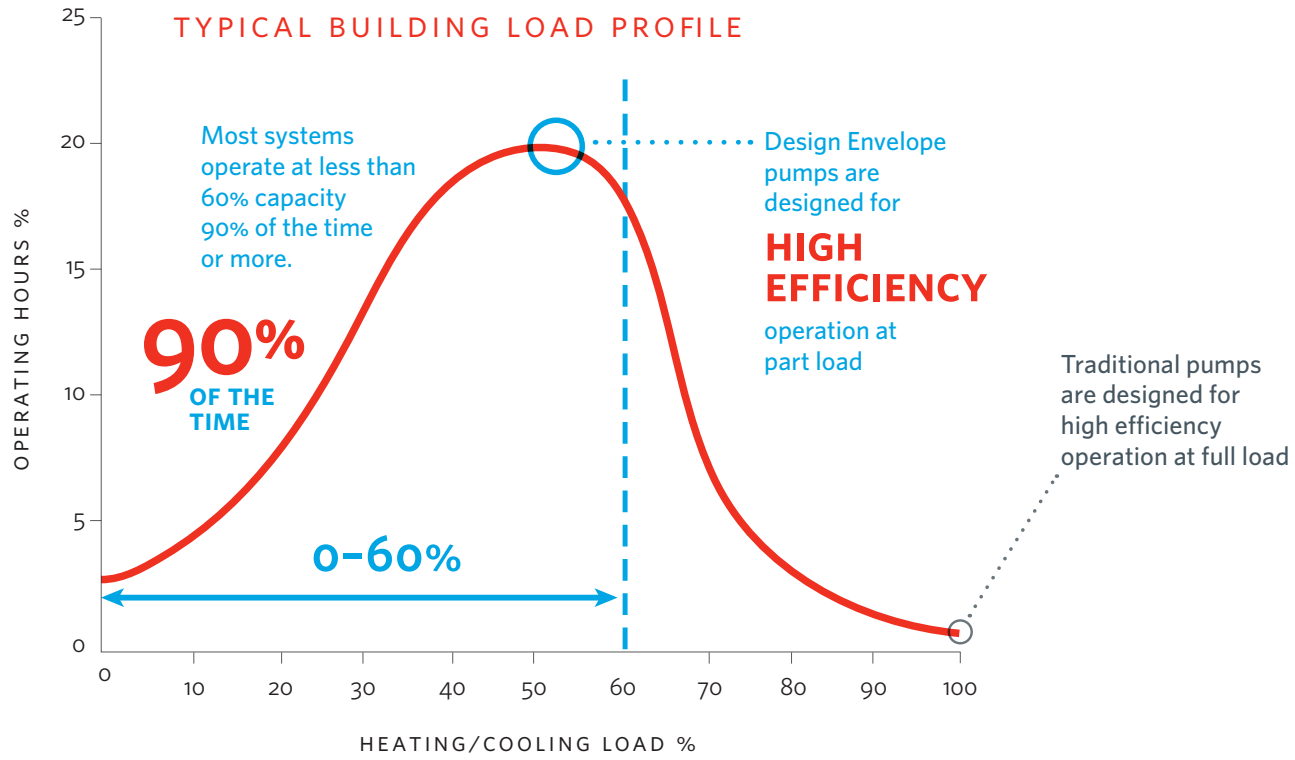
MAXIMUM ENERGY AND COST SAVINGS

UP TO **65%**

INSTALLED COST SAVINGS*

UP TO **90%+**

ENERGY SAVINGS*



Sizing and selecting for lowest energy consumption

Design Envelope solutions reduce pumping costs through demand-based operation — consuming only the energy required, based on current system demand. Design Envelope pumps use a combination of optimized impeller size, speed control and Active Performance Management for lowest energy use within a given performance envelope. The performance envelopes are selected for lowest energy consumption 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

1 TECHNOLOGY BENEFITS

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 ±5% accuracy. Design Envelope pumps deliver accuracy of ±5%.

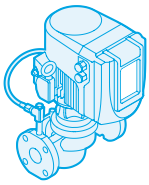
Highly accurate and reliable: no issues with fouling, so no need to service or re-calibrate.

Low installation cost: easy installation for retrofits.

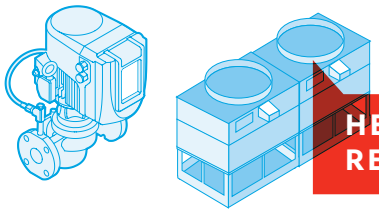
Integral to pump: no additional space or wiring required.

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

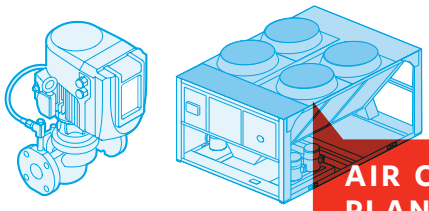
For evaluating an HVAC system, just two flow values and four temperature points provides all the data needed to understand flow rates, heat loads and operating efficiency.



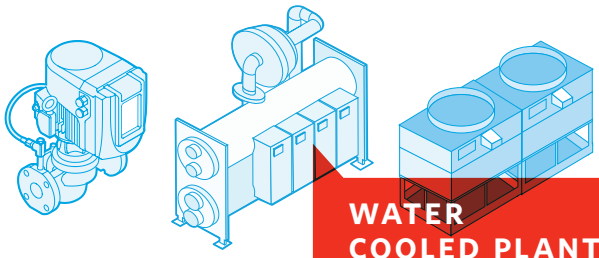
PUMPING SYSTEMS



HEAT REJECTION



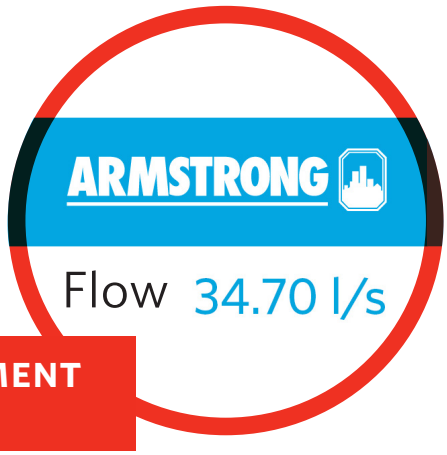
AIR COOLED PLANT



WATER COOLED PLANT

±5%

FLOW MEASUREMENT ACCURACY



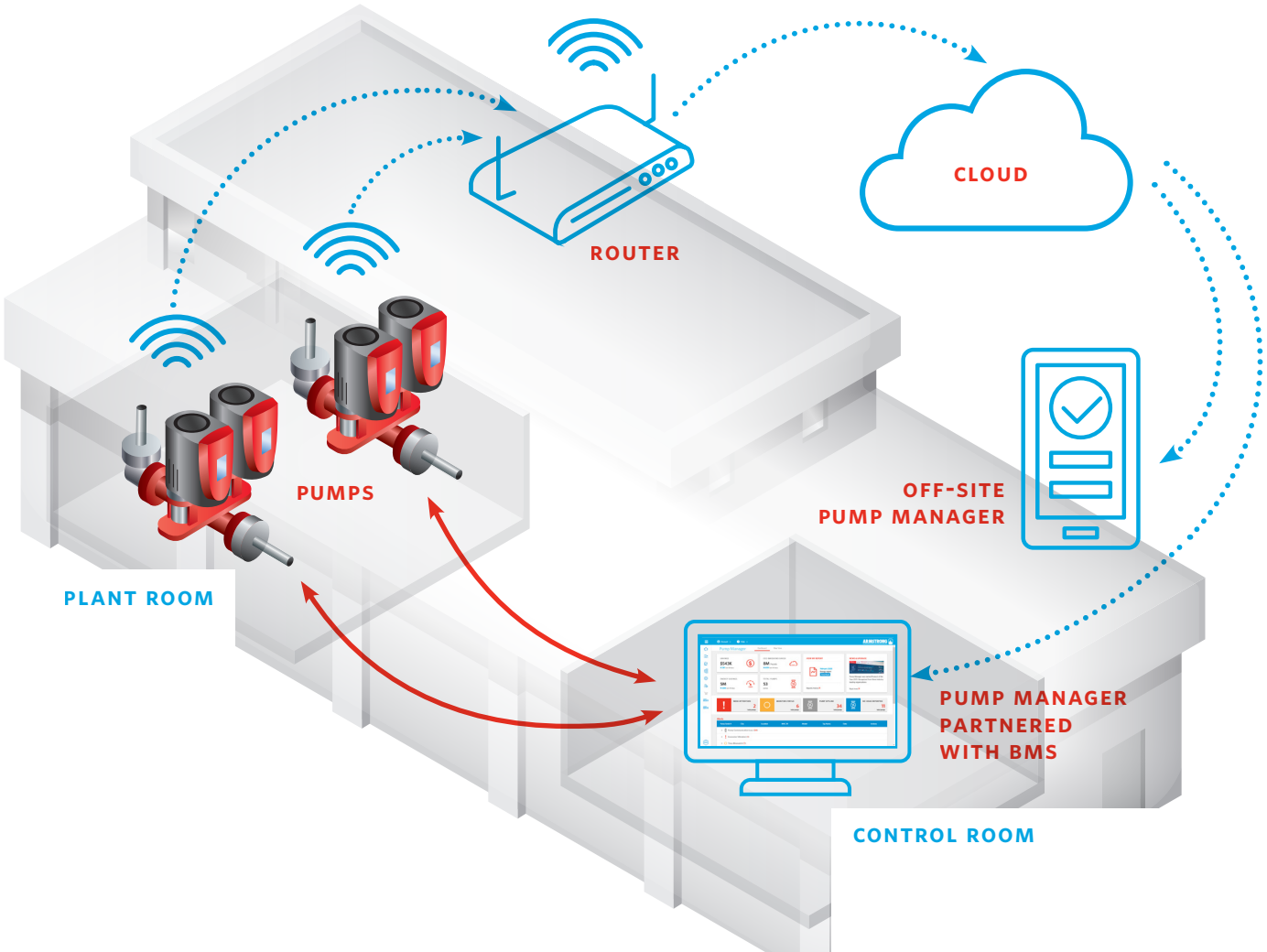
ACTIVE PERFORMANCE MANAGEMENT™

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



THE RESULTS

ENERGY SAVINGS UP TO **90%+**

LOWEST ENERGY USE

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 £22,400 annually.

FACILITY TYPE
Commerical office

LOCATION
Solihull, Birmingham

SIZE
Three-storey building

ANNUAL ENERGY COST

BEFORE	AFTER
32,152 £	9,752 £
AVERAGE	AVERAGE

ANNUAL COST SAVINGS **22,400** £

CO_2 EMISSIONS

BEFORE	AFTER
82,309 kg CO_2	24,967 kg CO_2
AVERAGE	AVERAGE

ANNUAL CO_2 EMISSION REDUCTION **57,342** kg CO_2

LOWEST
OPERATIONAL AND EMBODIED CARBON

LOWEST
PROJECT & OPERATING RISK

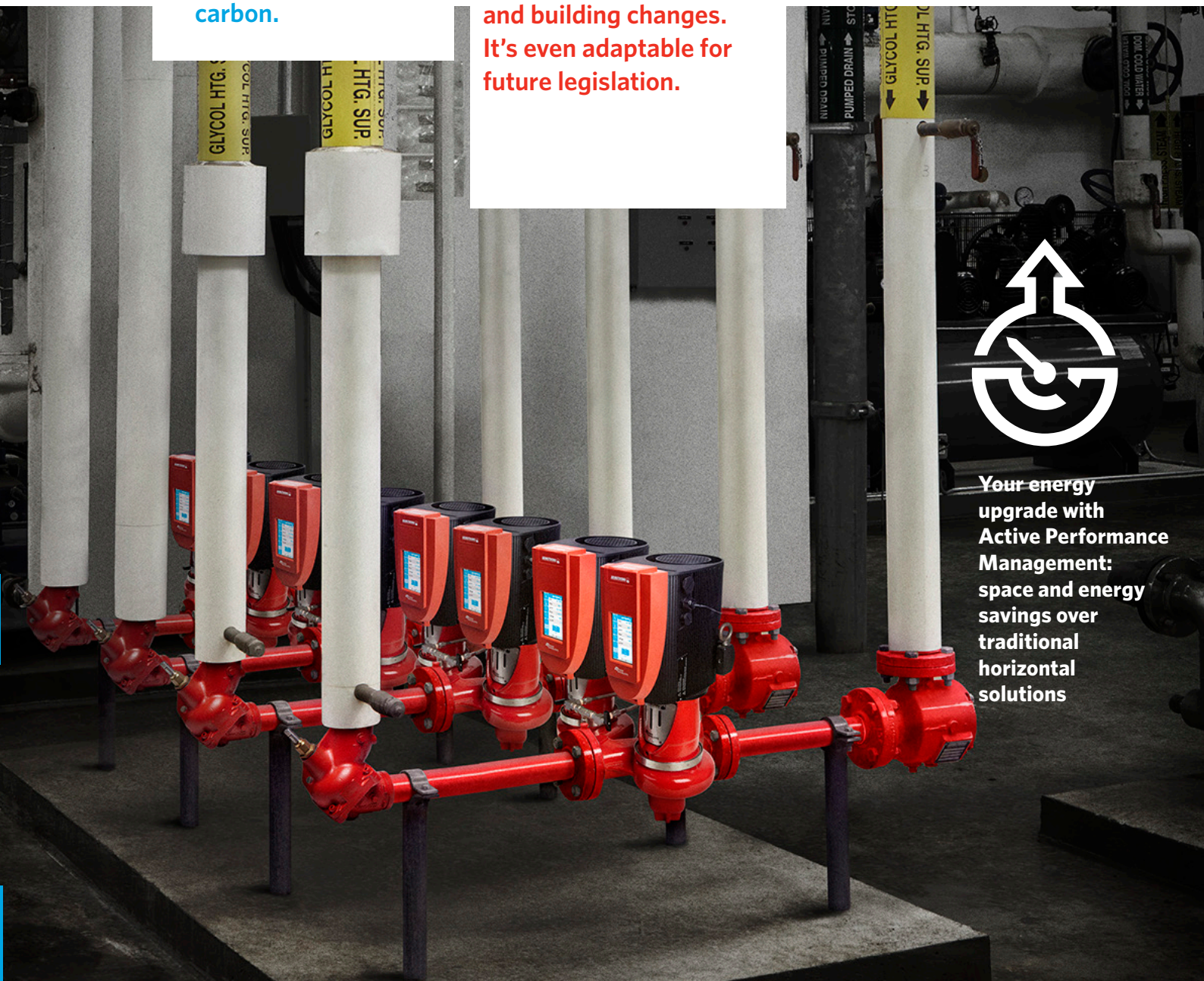
Together, these five key benefits of Design Envelope technology provide customer value far beyond alternative variable-speed or constant-speed solutions.

4

Design Envelope Pumps provide buildings with the lowest operational and embodied carbon.

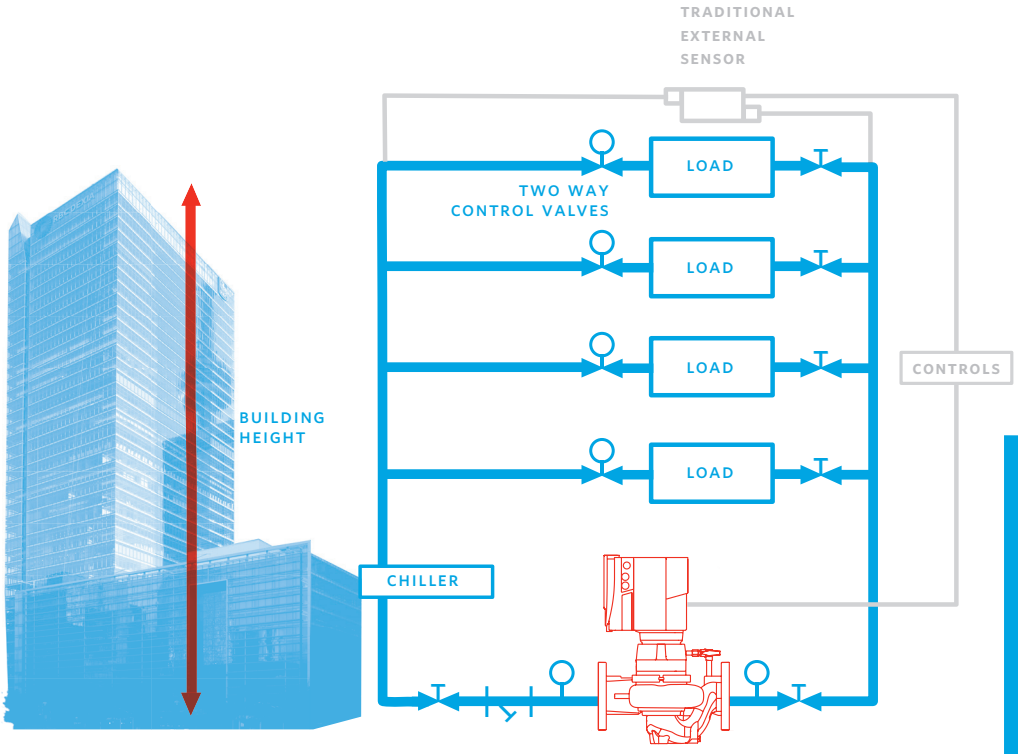
5

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



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

THE SENSOR WITHIN



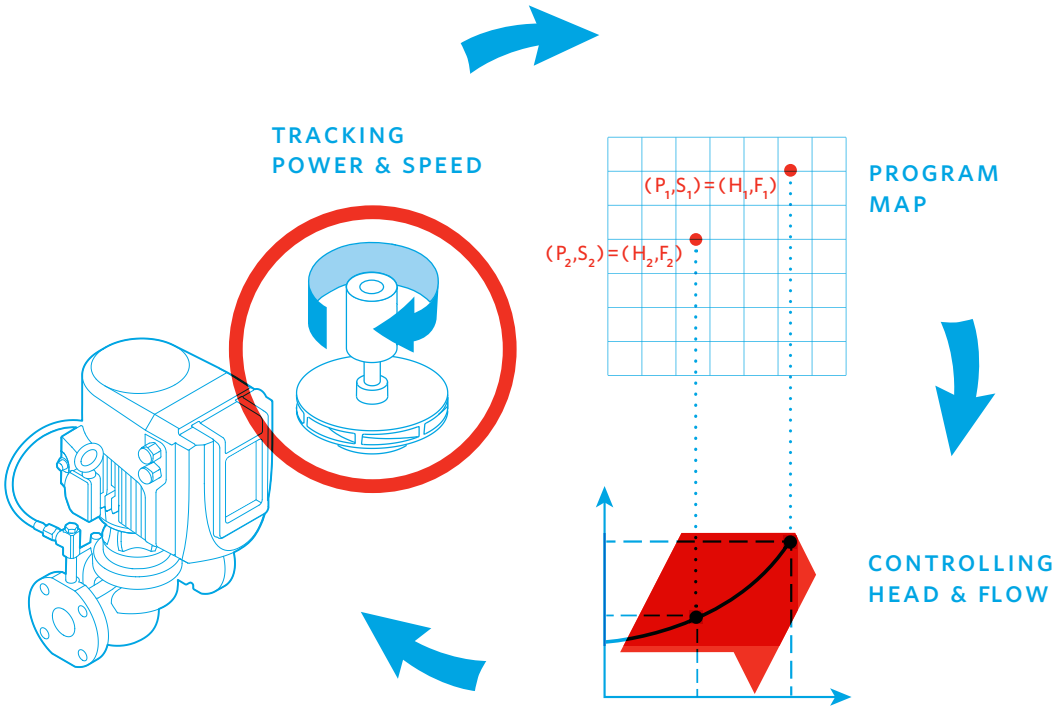
Equipped with Sensorless technology, Design Envelope solutions do not require an external sensor to monitor and control the HVAC load.

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 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 output.

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.

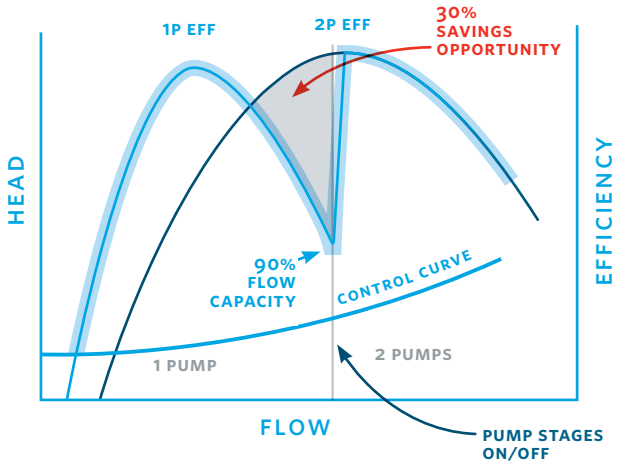
The traditional approach to control in a multi-pump installation involves staging pumps on the basis of motor speed. Parallel Sensorless Pump Control technology stages pumps based on operating efficiency rather than motor speed and improves the efficiency of the full pump array by up to 30% over traditional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

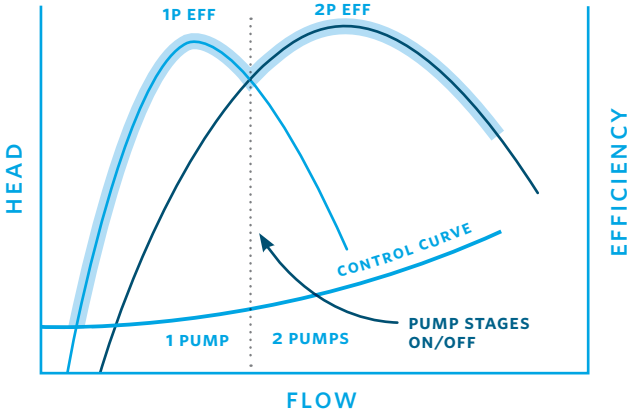
TRADITIONAL

SPEED-BASED STAGING



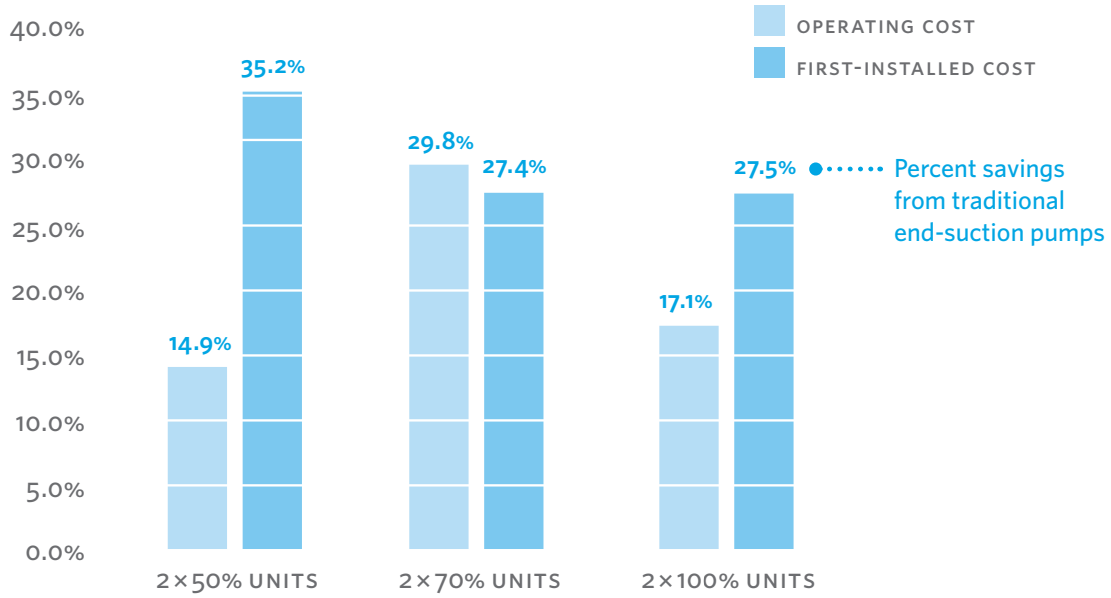
PARALLEL SENSORLESS PUMP CONTROL

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



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

3 THE SOLUTIONS

TANGO

DESIGN ENVELOPE | TECHNOLOGY

11–30 kW

A compact, uniquely designed, low-carbon dual pump that ensures uninterrupted fluid flow, even during maintenance

0.25–7.5 kW

UNMATCHED ENERGY EFFICIENCY

- Combines built-in redundancy with leading performance
- Includes embedded Parallel Sensorless Pump Control
- Lower pump and infrastructure costs
- DEPM motors provide Ultra Premium (IE5) efficiency
- 75% reduction in embodied carbon compared to conventional two-pump base-mounted installations
- Improved flow control for high turndown applications

THE NEED FOR AVAILABILITY

Most building HVAC systems use 100% of design-day capacity for less than 1% of operating hours.

Traditional design approaches over-size components to ensure that the design point can always be met. They also use duplicate, oversized components to achieve 100% redundancy. This needlessly increases both the cost and the carbon footprint of a building.

Design Envelope Tango's dual-pumping configuration modernises system design. Pumps and motors are selected from a range of sizes to achieve a level of redundancy that matches the requirements of the application. Design Envelope technology, in combination with Parallel Sensorless Pump Control, modulates the output of each pump individually, and the entire pump array to meet the flow requirements of the system and minimise energy use.

Pump Manager™

- Real-time operating insights and diagnostic warnings
- Full transparency in energy savings and carbon footprint reduction
- Reduce pump maintenance cost by up to 50% with predictive maintenance

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 | Delta Hotel

ANNUAL ENERGY SAVINGS
40%

The Delta Hotel commissioned an upgrade of one of their existing pumps to a new Tango. New control algorithms and performance management of the Tango pump proved that the upgrade was the right choice. The total annual energy cost savings amounted to over $2,295 with a total kWh savings of 22,957 kWh: a 40% savings overall.

FACILITY TYPE
Hotel

LOCATION
Toronto, Canada

SIZE
300,000 ft²

ANNUAL ENERGY COST

BEFORE	AFTER
5,659 $ CAD	3,364 $ CAD
AVERAGE	AVERAGE

ANNUAL COST SAVINGS **$2,295 CAD**

CO_2 EMISSIONS

BEFORE	AFTER
7,923 kg CO_2	4,709 kg CO_2
AVERAGE	AVERAGE

ANNUAL CO_2 EMISSION REDUCTION **3,214 kg CO_2**

VERTICAL IN-LINE PUMPS (VIL)

DESIGN ENVELOPE TECHNOLOGY

Mechanical room space savings

Pumps require minimal floor space or can be installed overhead

Reduced vibration

Optimally-designed, dynamically-balanced impeller and shaft assembly operates with minimum vibration

Lowest installed cost and embodied carbon

Component, Material and Labor savings: fewer fittings and no housekeeping pad 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; saves up to £500

For a 10 hp/7.5 kW pump, save £1,500 with pipe mounting and no inertia base

DEPM Single-Phase Pumps

Available in 1-phase 200–230v up to 2hp

DEPM IVS

AVAILABLE IN SIZES UP TO 45 kW

35–65% lower operating costs over conventional integrated pumps

Smaller motor and controls size on 40% of hydraulic selections for lower pump and infrastructure costs

Simplified handling with single point lifting

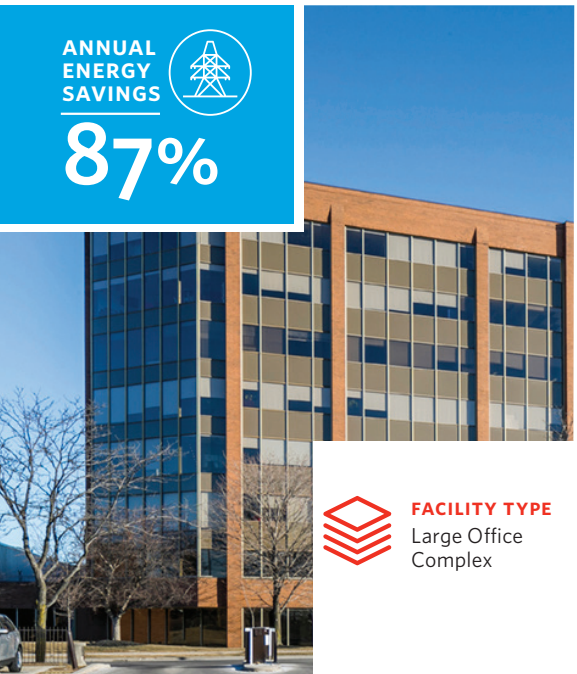
Meets Ultra Premium (IE5) Efficiency motor levels

50% weight reduction and 50% embodied carbon reduction

Available for outdoor operation

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
$140,072 CAD	$18,380 CAD
AVERAGE	AVERAGE

ANNUAL COST SAVINGS **$121,692 CAD**

CO_2 EMISSIONS

BEFORE	AFTER
150,847 kg CO_2	19,794 kg CO_2
AVERAGE	AVERAGE

ANNUAL CO_2 EMISSION REDUCTION **131,053 kg CO_2**

END SUCTION

DESIGN ENVELOPE | TECHNOLOGY

**NO INERTIA BASE NEEDED*
=SAVINGS OF**

£ 1,500 *10hp / 7.5kW or smaller

HVAC pumping systems are expected to operate smoothly and quietly.

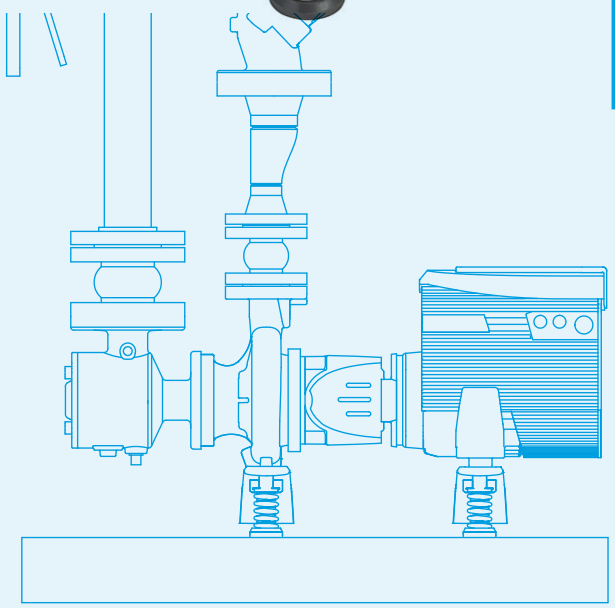
Although it's practical to mount pumps on the floor, this practice can also transmit noise or vibration to the rest of the building. Concrete and inertia bases have traditionally been used to mitigate vibration, but this adds excess weight and cost to the installation.

The new Design Envelope End Suction pump with integrated vibration isolation:

Eliminates the need for inertia bases

Reduces installed costs and operating cost

Adds more value than any other horizontal pump



EQUIPMENT AND MATERIAL SAVINGS

No inertia base, concrete and curing time required

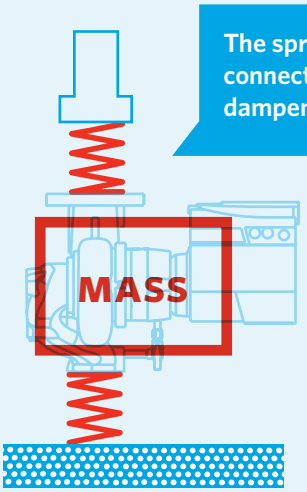
Rigid pump design needs no steel baseplate

No differential pressure sensors required

Less concrete means a lower carbon footprint

Integral vibration isolation eliminates the need for inertia bases or baseplates. The following features minimise the transmission of vibration:

- **Balanced rotor design**
- **Soft start controls**
- **Direct coupling to motor**
- **Reduced overall weight**

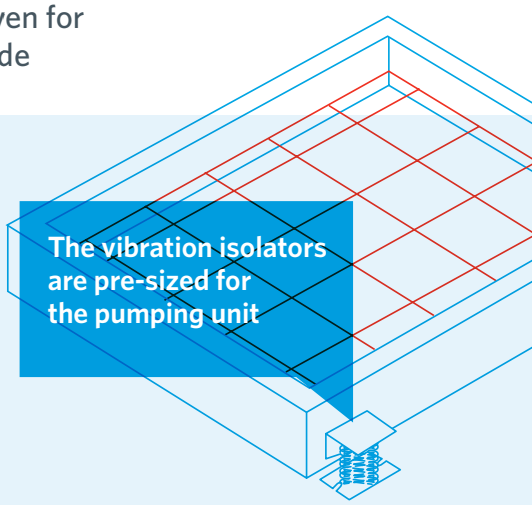


The springs and flex connectors act to dampen vibration.

With flex connectors separating the pump from the piping, and vibration isolators between the pump and the ground, the pump floats in an isolated spring system.

The ASHRAE handbook recommends the use of inertia bases even for pump installations on grade

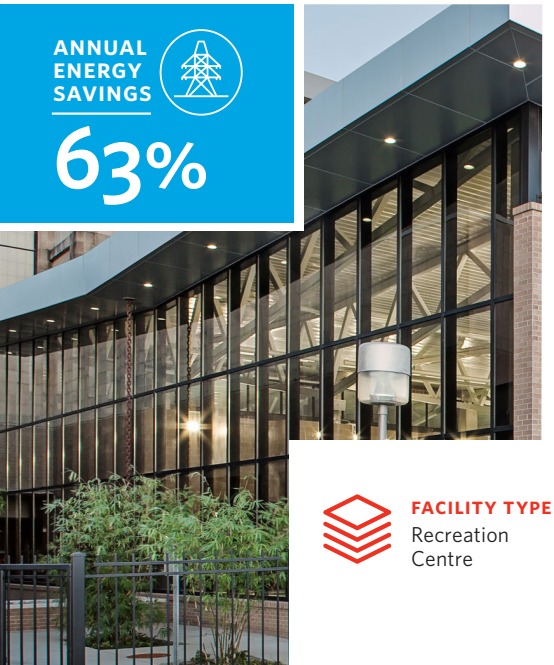
In pumps over 7.5 kW the integrated design with baseplate has a lower installed cost than a traditional pump with a wall-mounted drive



The vibration isolators are pre-sized for the pumping unit

CASE STUDY | Texas Christian University

ANNUAL ENERGY SAVINGS
63%



In 2018 Armstrong upgraded three constant-speed pumps in the Recreation Center. As a result of the retrofit project, TCU is saving over $7,500 per year.

FACILITY TYPE
Recreation Centre

LOCATION
Fort Worth, Texas

SIZE
179,831 ft²

ANNUAL ENERGY COST

BEFORE	AFTER
$12,106 USD	$4,525 USD
AVERAGE	AVERAGE

ANNUAL COST SAVINGS **$7,581 USD**

CO_2 EMISSIONS

BEFORE	AFTER
80,792 kg CO_2	30,193 kg CO_2
AVERAGE	AVERAGE

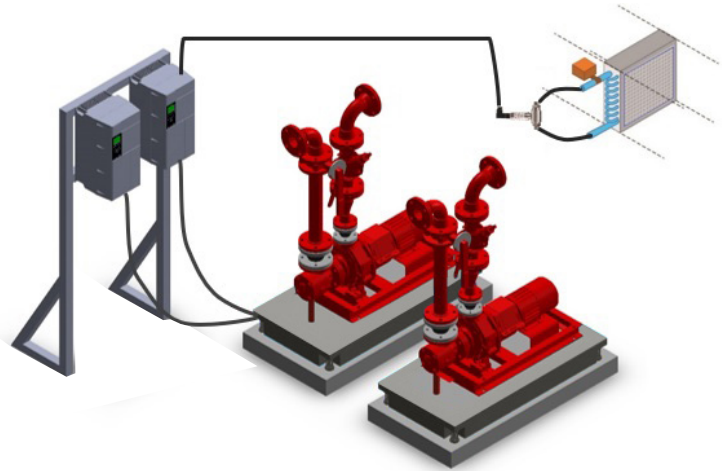
ANNUAL CO_2 EMISSION REDUCTION **30,193 kg CO_2**

CHOOSE YOUR CONFIGURATION

INSTALLATION COST COMPARISON

Armstrong is a leader in Embodied Carbon Reduction in our products.

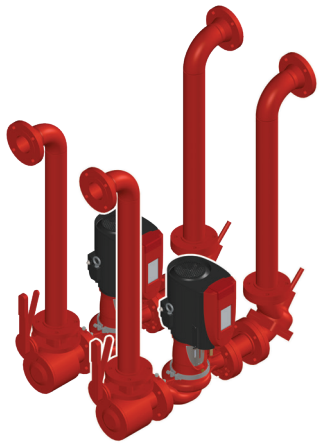
- Less material weight results in less embodied carbon in the product
- Elimination of inertia bases results in less embodied carbon in the construction/ installation stage



	2 × End Suction with drive on wall and remote pressure sensor 100% duty/standby	1 Tango pump with sensorless and parallel sensorless control 2 × 50% capacity split, parallel operation
Total pump weight	309.3 kg	41.3 kg 87% savings
Installation weight	1007.4 kg	236.3 kg 76% savings
Embodied carbon	7,671 kg CO_2e	1,231 kg CO_2e 84% savings
Installation footprint	2.47 m^2	0.54 m^2 78% savings
Installation cost	£ 7,163	£ 1,455 80% savings
	• Legacy design • Base case for comparison • Time-intensive seal change	• Managed redundancy and parallel operation replaces duty/standby • Smaller units are easier to handle • Two rotating devices sharing one casing • Reporting and proactive management • Optimised lifetime performance

Complete integrated solutions offer the lowest installed cost and add value in lifetime energy and maintenance savings

DESIGN ENVELOPE CONFIGURATION OPTIONS

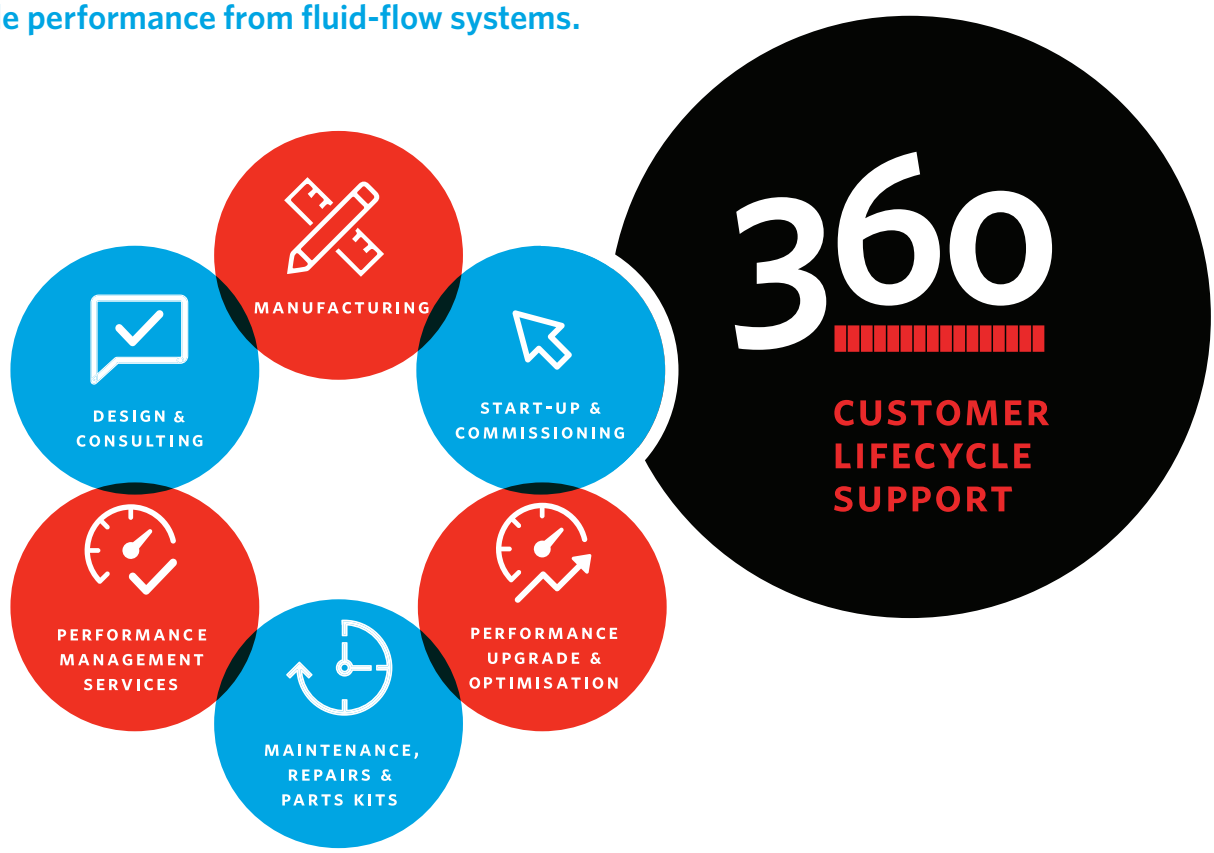


2 × Design Envelope Vertical Inline with sensorless control 100% duty/standby*	2 × Design Envelope End Suction with sensorless control 100% duty/standby*
98.0 kg 68% savings	89.8 kg 71% savings
339.3 kg 66% savings	435.9 kg 57% savings
2,135 kg CO_2e 72% savings	2,113 kg CO_2e 72% savings
1.14 m^2 54% savings	1.68 m^2 32% savings
£ 3,312 54% savings	£ 3,903 46% savings
Eliminates the need for: housekeeping pads, inertia base, flex connections, grouting and alignment • Reduced installation labour costs • Smaller mechanical room footprint (50–75%)	**Eliminates the need for:** housekeeping pads, inertia base, flex connections, grouting and alignment • Reduced installation labour costs • Smaller mechanical room footprint (50–75%)

*May also be sized 2 × 50% parallel

4 ARMSTRONG SERVICES & PARTS

Armstrong's 360 Service and Support provides complete solution support for engineers, contractors and owners. Working with our network partners, we provide support to help you get the best possible performance from fluid-flow systems.



Rapid response attention

MATCHED TO YOUR NEEDS.

24/7 GLOBAL RAPID RESPONSE

ARMSTRONG PARTS KITS: ENGINEERED AND PRE-ASSEMBLED

Armstrong Parts Kits are engineered combinations of genuine replacement parts — planned, selected and packaged based on solution types and sizes. Use Parts Kits for maintenance projects to add value to your building operators and service personnel.

CASE STUDY | Commercial Towers

FACILITY TYPE
Commercial office tower

LOCATION
Toronto, Ontario

SIZE
18 floors, 20,000 ft² per floor

ANNUAL ENERGY SAVINGS
77%

ANNUAL ENERGY COST

BEFORE	AFTER
$68,185 CAD AVERAGE	$15,918 CAD AVERAGE

ANNUAL COST SAVINGS
$52,267 CAD

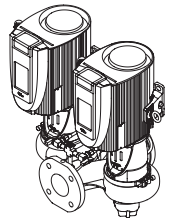
The owners of this pair of commercial towers recently completed an HVAC upgrade, replacing three constant speed pumps with new Design Envelope pumps with Pump Manager.

Along with the energy savings, Pump Manager provided system warnings that helped avoid expensive repairs and energy losses.

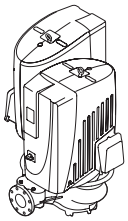
SOLUTION EMPLOYED
DESIGN ENVELOPE
VERTICAL IN-LINE PUMP

5 DESIGN ENVELOPE PUMP RANGE

4322/4372
Split and close-coupled Tango

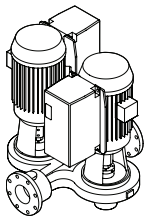


4332
Split-coupled Tango



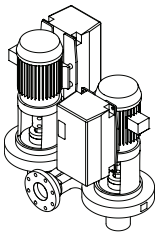
INDOOR	OUTDOOR
0.25-7.5 kW	0.25-7.5 kW
11-30 kW with isolation valves	11-30 kW with isolation valves

4302
Split-coupled dualArm



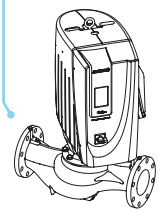
INDOOR	OUTDOOR
11-75 kW	11-75 kW

4312
Split-coupled Twin



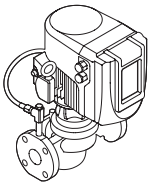
INDOOR	OUTDOOR
11-30 kW	0.75-30 kW

4300
Split-coupled vertical in-line



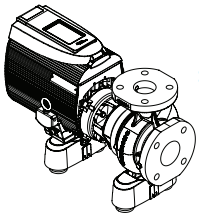
INDOOR	OUTDOOR
0.25-335 kW	0.25-90 kW
355 kW - 932 kW with Standalone control	N/A

4380
Close-coupled vertical in-line

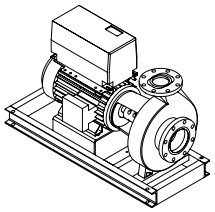


INDOOR	OUTDOOR
0.25-7.5 kW	0.25 -7.5 kW
0.75-1.5 kW in Stainless Steel	N/A

4200H
Split-coupled end suction

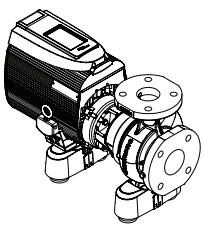


4200H
Split-coupled end suction



INDOOR	OUTDOOR
0.75-7.5 kW with integrated vibration isolators	N/A
11-90 kW	N/A

4280
Close-coupled end suction



INDOOR	OUTDOOR
0.75-7.5 kW with integrated vibration isolators	N/A

OUR SERVICE TO THE PLANET

PLANET PROPOSITION

Through our Planet Proposition charter, Armstrong has committed to minimising our impact on the environment. Around the world, Armstrong's Planet Proposition teams have taken on projects that are helping us meet our targets. Two examples of successful projects are:

NET ZERO CARBON BUILDINGS COMMITMENT

The Net Zero Commitment positions energy efficiency as a central component to achieving decarbonization globally. In signing the Net Zero Carbon Buildings Commitment, Armstrong has pledged to ensure our entire portfolio of buildings operates at Net Zero carbon by the year 2030.

WATCH THE VIDEO

See how we achieved a key target in reducing greenhouse gas emissions by 2 millions tons

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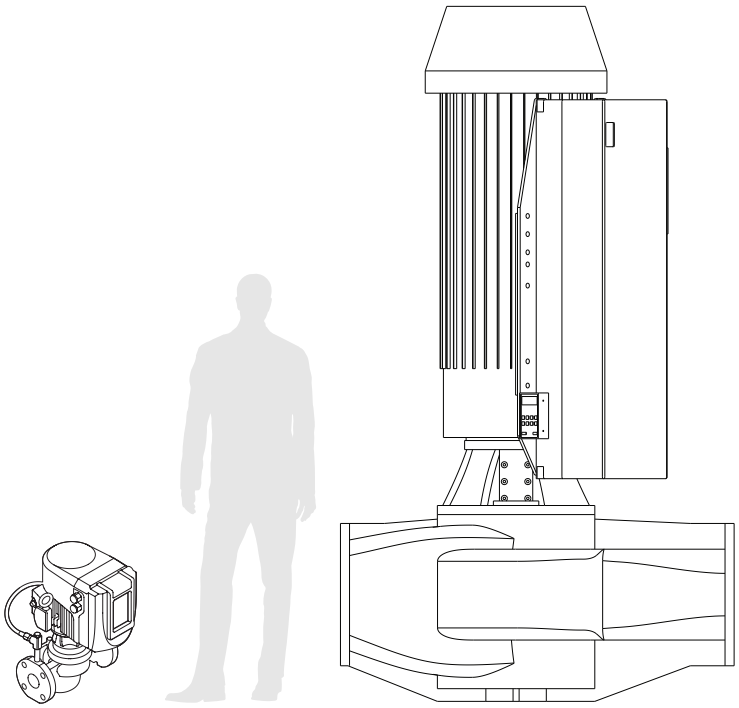

0.25 kW **Up to 932 kW available**

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