ECO:nomics

A LOWER CARBON FOOTPRINT AT NO EXTRA COST

Experience Building… A Sustainability Platform

ARMSTRONG

A Message from Charles Armstrong

We have entered the era of the sustainability imperative. Many of you have already embraced the environmentally sensitive Building Research Establishment's Environmental Assessment Method — BREEAM. Whether driven by social, environmental or fiscal responsibility, forward-thinking organisations are embracing energy-saving technologies and practices. Energy demand abatement has never been more important.

Armstrong has been helping the world implement sustainability strategies for the last twenty years of its 80 year history through design excellence based on the following engineering principles: ease of maintenance, the advantages of variable speed technology, 'whole system' controls design, integration of renewables, and the 'Design Envelope' model.

These five principles support our commitment to deliver a lower carbon footprint and higher energy efficiency to our customer base at no extra cost.

Further to this commitment, we are developing tools to help our customers understand GHG emissions and cost savings at individual installations. For example, the payback period of some of our low-carbon line has been calculated to be as low as two years – an unprecedented value in our industry.

Now is also the ideal time to take advantage of the many government energy rebate programs, which offer substantial financial incentives for the industrial, commercial and institutional sectors …all designed to drive down the total cost of ownership. Furthermore, depending on the circumstances, your average annual energy savings may fully pay for the related lease costs of our equipment.

All of these opportunities are detailed in our PLATFORM FOR SUSTAINABILITY – one of the most comprehensive energy solution-based programs in our industry. Our technical support team will help you develop a sustainability platform using our integrated systems and low carbon technologies. Work with us to leave no option unexplored.

Experience Building… A sustainability platform with ARMSTRONG.

Charles Armstrong
President

Innovation and Integration for Low Carbon Solutions

For over a decade, Armstrong has focused a large proportion of its investment specifically on research and development of low carbon technologies. This concentration of effort has enabled us to bring to the customer a suite of technically-advanced solutions which lower the carbon footprint of buildings at no extra cost.

The ten key low carbon solutions outlined in this brochure offer tangible financial paybacks across a wide range of applications, from small to large scale projects, and for buildings of all types, commercial and industrial, private sector or public sector.

ECO:nomics presents these solutions alongside one another for the first time, in a single brochure, enabling all specifiers and stakeholders to pinpoint more easily the appropriate solutions for their projects.

Armstrong's low carbon solutions are characterised by the following advantages:

1. Flexibility to adapt to changing building loads without 'over-sizing' and/or loss of energy efficiency performance.

Design Envelope is a sustainable design practice underpinning all ECO:nomics solutions, which reduces levels of risk for project specifiers and building occupiers. It harnesses the power of advanced control technology to enable HVAC systems to respond to the challenges of climatic variability and changing building use without compromising energy efficiency. This provides an effective alternative to traditional practices such as 'over-sizing' which are known to have repercussions of wasted energy and unnecessary carbon emissions.

2. Unprecedented energy efficiency at part load

Variable speed and variable load solutions bring unrivalled levels of performance across a building's full range of environmental conditions.

3. Integrated control for best possible performance at all times

Recognising that world-leading energy efficiency performance can only be achieved by whole system control, our solutions use innovative control methodologies which enable demand to be balanced across the component parts of the system for the best wire-to-water efficiency at all times. Each component of the system is operated automatically to exploit its energy efficiency potential to the full. Developed ahead of the Energy Using Products Directive, our integrated control has provided a timely and cost-effective solution for specifiers needing to satisfy these European regulatory requirements.

4. Expert technical input

Design Assist is an added value service offered by Armstrong which provides specifiers and stakeholders with detailed energy calculations to forecast energy consumption and determine the system payback period. Alternative system designs can be explored thoroughly and compared prior to any project, and competitive leasing options can offer new opportunities to achieve sustainability objectives.

5. Integration of renewable energy sources without expensive customisation

Armstrong is successfully combining low carbon solutions such as solar thermal, heat pumps, biomass boilers and condensing boilers with proven mainstream HVAC solutions to achieve outstanding environmental performance without any need for untried, untested and difficult to maintain non-standard equipment and system choices.

Our mission: to have a dramatic positive impact on the bottom line of each customer providing a lower carbon footprint solution with high energy efficiency, enabling the customer to experience financial paybacks that are unprecedented in our industry.

The Design Envelope

Optimise Efficiency with a Wider Range of Operation

When fixed speed system performance criteria were based on a narrow band of Design Day conditions, optimising for occupant comfort often meant sacrificing operating efficiency during part-load conditions. Prior to variable speed drives, the accepted industry practice meant designing heating, cooling and plumbing system performance around a single point that represented the most extreme conditions that a building might experience during its operating lifecycle. To mitigate equipment performance risk, standard industry practice had been to add another 10-15% of safety margin to ensure performance. This traditional sequence of events led to HVAC system designs, that at part-load, are susceptible to instability, poor occupant comfort and inefficiency.

Variable Speed Controls Optimise Efficiency

Design teams continued to define equipment capacity on a fixed load point – the Design Day – and select equipment on a pro-rated efficiency weighting for part-load conditions. Knowing that most buildings operate away from Design Day up to 97% of the time, a comparison of more realistic energy optimisation solutions can be made. The reality of building design is that from the point of conception through to start of construction, the Design Day load point typically changes 3-5 times, from 5-15% higher or lower than the first assessment. This means that the mechanical room equipment has to be reselected 3-5 times.

Ideally, the building designer would like to select equipment that can meet part-load performance criteria from a Design Day load, plus or minus 15%. Ideally, the equipment manufacturer can provide the designer with equipment that can meet the required part-load performance based on the required range of Design Day loads (the +/- 15%). Welcome the Design Envelope.

The Design Envelope – A Sustainable Solution

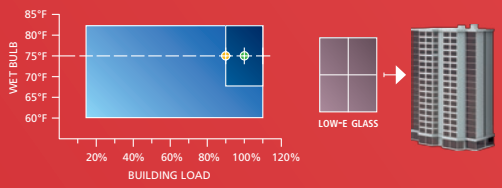
The Design Envelope is a new way of approaching the HVAC and plumbing equipment selection process for pre-engineered, integrated, factory-built solutions. A designer can specify a range of possible design days (The Envelope). Right-sizing within the Design Envelope provides greater design flexibility, eliminates equipment "re-selection" thereby reducing design risk and can facilitate integration of future complementary systems (such as renewables) without requiring a redesign of the base plant. As a result, original equipment can serve the building requirements for its maximum lifespan, making this a sustainable solution throughout the building's life, and a more sustainable selection through the design phase.

The Design Envelope for Armstrong variable speed equipment is made possible through new control methods. These control sequences enable the great part-load efficiencies expected, regardless of the selected Design Day.

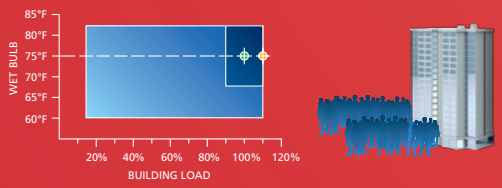
Future-Proofing

The Design Envelope also provides building owners with the necessary adaptability to changes that can occur during a building's operating life. Typically, a building's load can change because:

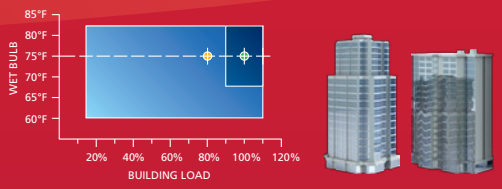
Changes have been made to the original design;



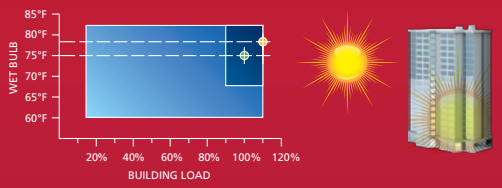
The occupant density has increased;



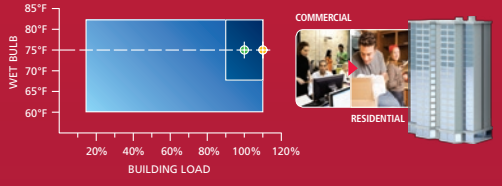
Changes to shade conditions caused by modifications to adjacent buildings;



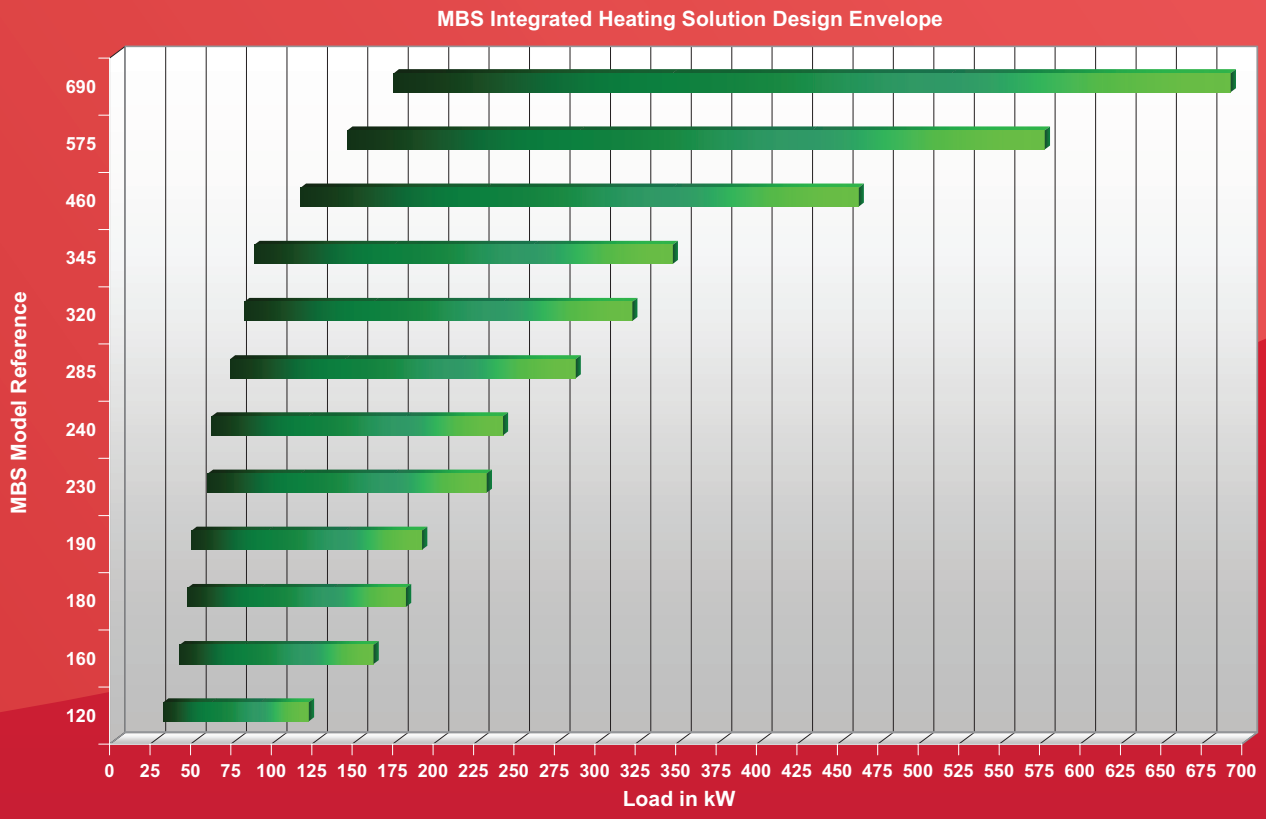
Global warming and related environmental changes;



Original operation intent has changed;



Forward thinking developers and building owners recognise that with the Design Envelope, systems can be future-proofed to accommodate changes in occupancy levels and climate.



The operating envelopes of the MBS Integrated Heating Solution are able to achieve overall seasonal efficiencies of over 90% because the heat output constantly matches the building load.

Two variables affect condensing boiler system efficiency; system return temperature and load. The lower the system return temperature and load, the higher the efficiency. The MBS controller automatically runs all boilers at their lowest possible output and temperature within the Design Envelope to satisfy the building load.

The **Design Envelope** method is a best practice that delivers you and your customer a fixed budget for cost and space from the very beginning. It frees you up to work with your architect and engineer on a range of building design options with full knowledge of your final costs up-front. In fact – **it helps to optimise energy consumption as the building changes through design and operating life.** And by reducing the need for change orders, it will help reduce project risk and project delays.

ECO:nomics

…is an integrated approach to sustainability in the contracting value network which eliminates first cost premiums to a building's sustainable development. With the traditional 'tradeoff' decision making eliminated, owners, designers and contractors are free to pursue increased value in their own revenue stream thereby profiting from embracing a sustainable strategy for their business.

~Charles Armstrong

Ten Solutions, Ten Low Carbon Footprints

1.

IVS INTELLIGENT VARIABLE SPEED BOOSTER SYSTEM

A building owner installed an IVS Booster System to supply constant pressure to the uppermost floors of the building and to counter varying usage and irregular city water pressure. **This eliminated the need for energy-wasting, pressure-reducing valves** that are standard on constant speed booster systems.

2.

VERTICAL IN-LINE PUMPS OPERATING IN PARALLEL

A large apartment building in Florida recently underwent a retrofit, replacing two horizontal split-case pumps with two 37 kW, 50% duty Vertical In-Line pumps that operate in parallel with 80% redundancy. The apartment building is now using one pump exclusively and **saving £30,000 a year in energy costs.**

3.

IVS INTELLIGENT VARIABLE SPEED PUMP

Devon County Council installed IVS (Intelligent Variable Speed) technology in six educational buildings to reduce their carbon footprints and operating costs. Thanks to the Armstrong IVS Technology, the Exeter schools are **keeping energy consumption to a minimum.** They are operating at a reduced speed with more accurate control, which means greater comfort for building occupants, and a long, reliable equipment lifespan.

4.

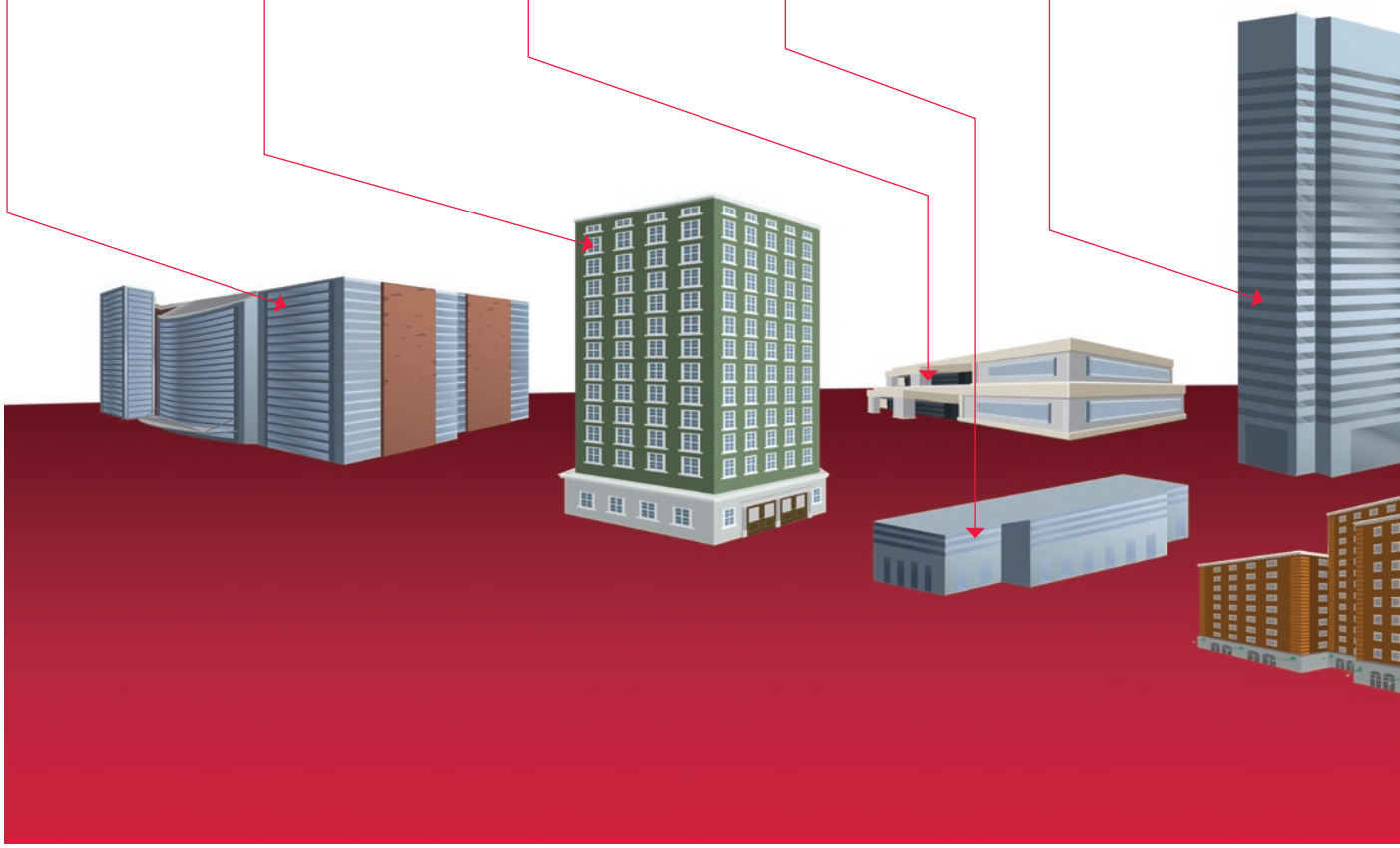
IPS INTEGRATED PUMPING SYSTEM

The ATOS Origin project team made it a priority to select HVAC equipment which minimises the carbon footprint of the new data center building, while maintaining the correct environmental conditions for large-scale computing equipment that operates on a 24/7 basis. **Energy savings of up to 47.5% in these systems are achieved** by incorporating variable speed drive pumps with IPS pump control, instead of a constant speed, constant volume system.

5.

FREE COOLING AND VARIABLE FLOW PLATE HEAT EXCHANGER SYSTEMS

In the prestigious 66 story high rise building on Lexington Avenue in New York City, an Armstrong high pressure S96 plate heat exchanger reduces cooling costs. Energy calculations show a potential of **25% savings when operating the system in the free cooling mode** under typical seasonal temperatures. The resulting occupant comfort also means lower turnover rates.



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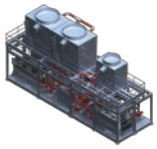


ULTRA-EFFICIENT CHILLED WATER INTEGRATED PLANT PACKAGE (IPP)

This IPP installation for a San Diego medical centre **exceeded the specification for energy efficiency, averaging a CoP of 6.2 plant efficiency.** The plant has also remained within the lowest operating efficiency criteria of CoP of 4.7.

7.

ULTRA-EFFICIENT CHILLED WATER INTEGRATED PLANT CONTROL (IPC)

This IPC installation for Humber College provided **energy savings of over 48%,** with net annual savings estimated at 1,500,000 kWh.

8.

ULTRA-EFFICIENT INTEGRATED HEATING SOLUTION (MBS)

The MBS is part of an innovative solution for 215 apartments in the UK. Along with our IVS Sensor-less Pumps, and our Plate and Frame Heat Exchangers, **the systems are capable of operating on 10% renewable energy integration.** Solar energy will be used for both space heating and domestic hot water generation.

9.

ARMSTRONG E-SERIES CIRCULATOR

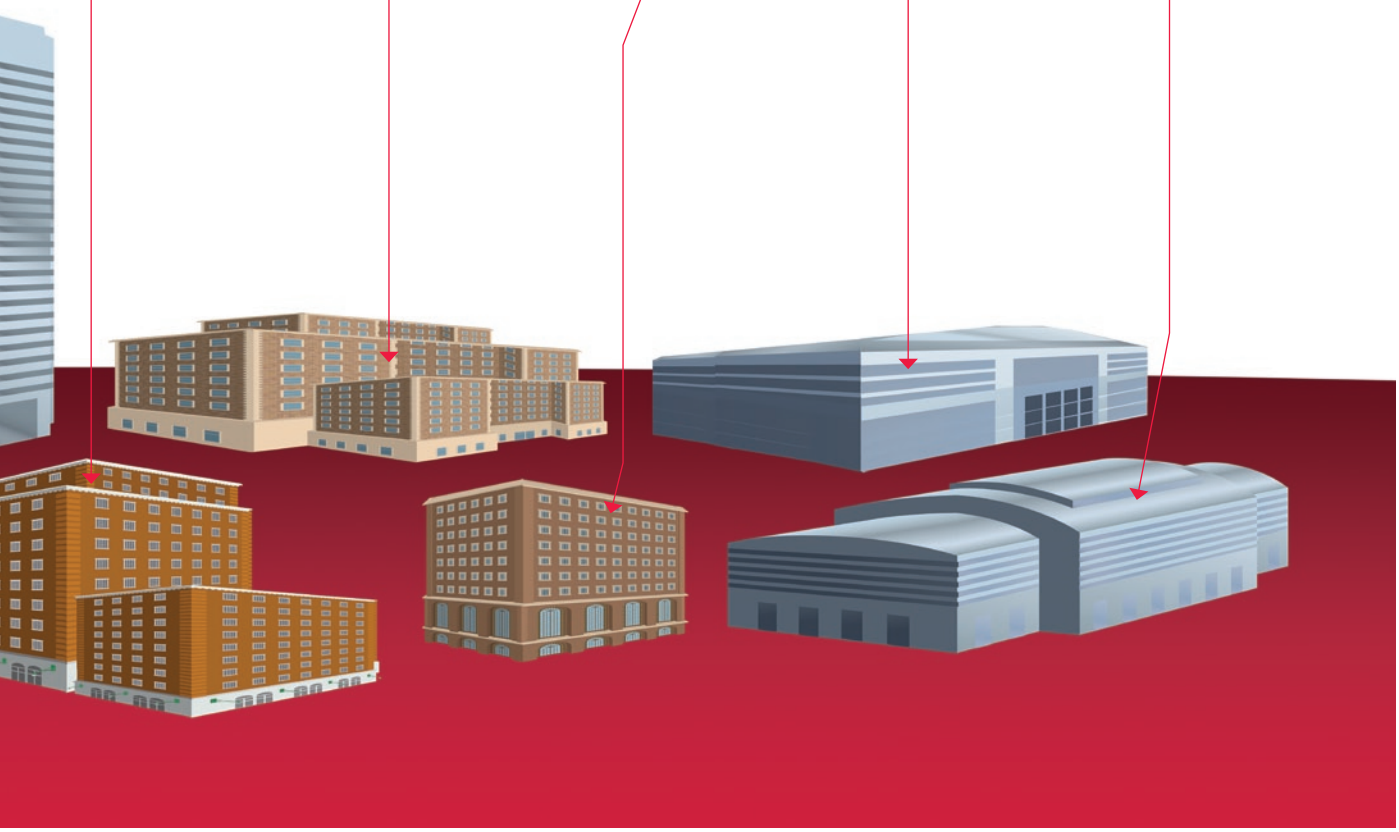
Compared to a standard wet rotor circulator, the E-series Circulator will **save up to 18% in energy costs** for the life of the pump. It also includes the ability to, in the future, repair rather than replace. This offers additional cost savings, an even lower carbon footprint, and better landfill avoidance.

10.

DESIGN ASSIST

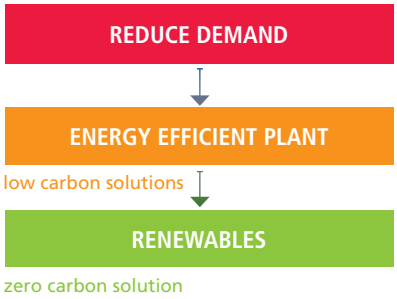
ARMSTRONG DESIGN ASSIST

Design Assist is a professional service that optimises mechanical room layouts and is a direct response to marketplace demand for energy efficiency and sustainability. It delivers **a lower equipment cost, improved specification performance, reduced energy consumption and a lower initial carbon footprint.** Glendale Arena, in California, realized the space savings, and they accommodated a doubling in total plant capacity, saving the owner an additional £300,000 for Phase II expansion.



Integrating Green Energy

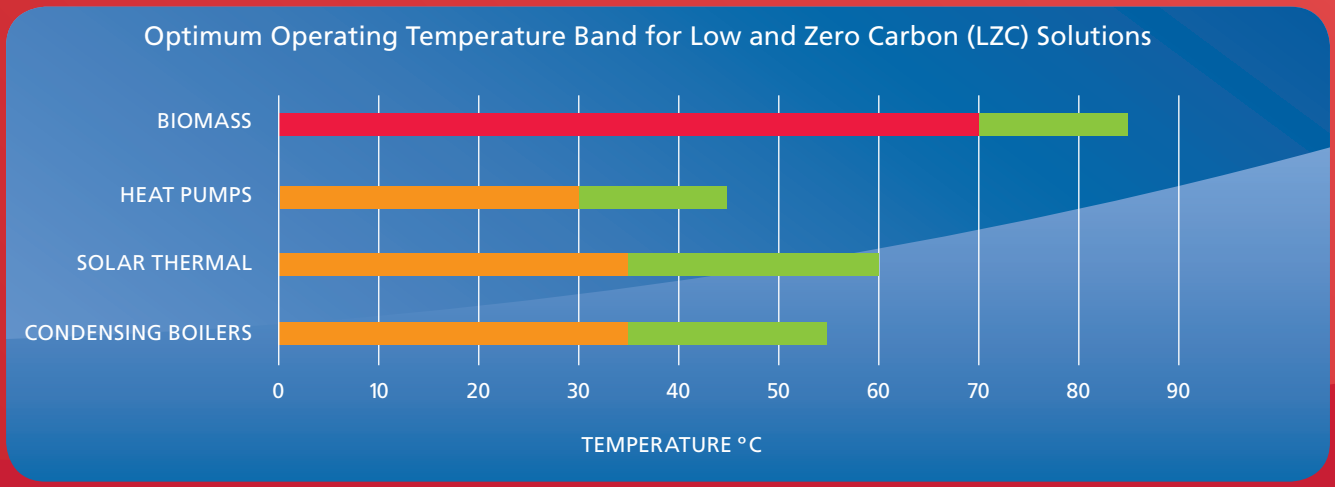
The case for reducing our energy consumption is compelling. We believe that a three-stage approach often works best.



First – Reduce demand by good thermal insulation, solar shading, good air tightness and demand controlled ventilation.

Secondly, utilise the low carbon solutions and Design Envelope practice of specification.

Once we've reduced the demand and the load, we can add in the final piece – Renewables. But here's the catch! The range of renewable solutions currently available operate at different temperatures for best efficiencies.



If we are to get the best out of our LZC (Low and Zero Carbon) solutions we can't look at each of them in isolation. If they are to work together in the same system, they need to be fully integrated so that the conflict between the different operating temperature ranges is effectively managed.




As an example, when we combine biomass boilers with back-up condensing boilers we have a problem. Biomass wants to run at around 80°C whilst condensing boilers need to operate below 55°C. If we're not careful, we can quickly lose any benefit we might have gained from incorporating renewables in our design.

So, we need to diligently integrate each of the zero and low carbon solutions so that they operate in harmony as one synchronous system and not separate stand-alone sub-systems. By incorporating a suitably designed thermal store with an intelligent master controller, we can satisfy the high temperature demands of the biomass boiler whilst at the same time ensuring that the system return conditions enable the back-up boilers to operate in condensing mode.

Armstrong has developed a number of Low and Zero Carbon Solutions that successfully combine solar thermal, heat pumps, biomass boilers, condensing boilers and CHP units using our innovative Design Envelope philosophy and our unique LZC (Low and Zero Carbon) Integrated Master Controller.

The result is a pre-engineered solution built off-site in our plants in Buffalo, NY or Birmingham, UK that satisfies our need to provide best-in-class energy efficient equipment complimented by renewable technology that works first time, every time.

BREEAM Certification

Contributing to third party certifications such as BREEAM, LEED® and BOMA Go Green for our customers is an indicator of our ability to design and manufacture to the best possible sustainability standards. We have successfully helped many of our clients achieve certification while remaining within their budgets for retrofits and new systems. For further information, contact Armstrong at greenteam@armlink.com

Take Advantage of Government Energy Rebates

Government grants and rebates are available for new energy-efficient equipment, retrofits of selected applications, or improvements of any energy consuming processes. Armstrong will work through technical issues to identify and quantify cost savings and can help you determine what rebates are available in your area. For information, please contact Armstrong at greenteam@armlink.com

ECO:nomics

…ability to improve, in a measurable way, operational performance metrics at no additional or lower costs.

~Tony Meo

Our Core Values

Armstrong is dedicated to the core values of Community, Service and Innovation.

We are building an organisation that maintains a sense of commitment to the community, to our partners and to our customers. We will keep our promises and we will pursue knowledge that will enable us to serve our community and add value to it.

We are building an organisation that nurtures and builds loyal relationships with employees, partners, and customers while performing interdependently. We encourage trust by demonstrating integrity and influencing positive change.

We are building an organisation that continually explores new ideas with our customers through learning and innovation.

'Experience Building…' is an expression of our brand promise. It's an invitation to partner with Armstrong and experience the rewards of building – building solutions, building the industry, building your business, and building a sustainability platform that has a lower carbon footprint at no extra cost.

At Armstrong, we define **sustainability** as the practice of meeting the needs of today, without compromising those of the future. For us, **sustainable design** is providing a solution which minimises the negative impact on the environment.

Armstrong has been helping the world to implement sustainability strategies over the last twenty years through design excellence integrated with the following engineering principles:

1. Design to reduce investment and improve maintainability
2. Design for the variable speed world we live in
3. Apply Design Envelope concepts in order to reduce risk
4. Adopt a 'whole system' approach to controls
5. Design for the integration of renewable energy sources

These principles support Armstrong's practice of ECO:nomics – helping our clients achieve maximum energy efficiency and performance at no extra cost.

If every potential customer in the UK installed Armstrong heating and cooling systems, they would contribute to reducing GHG emissions by about 4 million tons per year. This would save approximately 362 million cubic meters of natural gas and 8 million MWh of electricity.

This is equivalent to taking 1 million cars off the road. Think about it.

ECO:nomics
…is the sustainable environmentally oriented solution that reduces life cycle costs and improves comfort with positive impact on revenue stream
~Peter Thomsen

A few of our Clients

- Enwave Deep Lake Water Cooling System - Toronto, Canada
- RBC Centre - Toronto, Canada (LEED Gold Targeted)
- Cherapa Place - Sioux Falls, USA (LEED Certified)
- Seneca College - Toronto, Canada (LEED Targeted)
- Humber College - Toronto, Canada
- Hibernia Project - Newfoundland, Canada
- Torre Mayor - Mexico City, Mexico
- 63 City Tower - Seoul, South Korea
- World Financial Center - New York City, USA
- Canary Wharf - London, England
- First Canadian Place - Toronto, Canada
- US Embassy - Kabul, Afghanistan
- Heathrow Airport - London, England
- AstraZeneca Pharmaceuticals - Manchester, England
- LG Corporate Headquarters - Beijing, China
- Nissan Headquarters - Nashville, USA
- Battery Park - New York City, USA
- Atlantic Station - Atlanta, USA
- Echelon Resort and Casino - Las Vegas, USA
- McCormick Place - Chicago, USA
- Data Centers - Charleston, Pryor, Chicago, San Antonio, Quincy, USA
- Revel Casino - Las Vegas, USA
- Wachovia Data Center - Charlotte, USA
- ACC5 Data Center - Alexandria, USA
- Four Seasons Hotel - Denver, USA
- MGM City Center - Las Vegas, USA
- San Diego Health Center - San Diego, USA
- West Covina Civic Center, West Covina, USA
- Garden Walk - Anaheim, USA
- Veterans Hospital - Lancaster, USA
- Clark County School District - Nevada, USA
- One Bryant Park Bank of America - New York City, USA
- 270 Greenwich Street - New York City, USA
- Bellevue Hospital - New York City, USA
- Rockefeller University - New York City, USA
- Empire State Building (Retrofit) - New York City, USA
- Goldman Sachs - New York City, USA
- Orlando Utilities Commission Central Plant - Orlando, USA
- Tampa General Hospital - Tampa, USA
- Doral Golf and Country Club - Miami, USA
- New York Public Library - New York City, USA
- 44th Street Hotel - New York City, USA
- NYU Langone Medical Center - New York City, USA
- New York Law School - New York City, USA
- Carnegie Library - New York City, USA
- Atos Origin - Basingstoke, England
- HSBC - Welwyn Garden City, England
- BBC Media City - Manchester, England

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