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IHEA
Institute of Healthcare Engineering, Australia

HEALTHCARE FACILITIES

IHEA NATIONAL CONFERENCE 2025

Future proofing healthcare building systems - getting the basics right

26-28 MAY 2025
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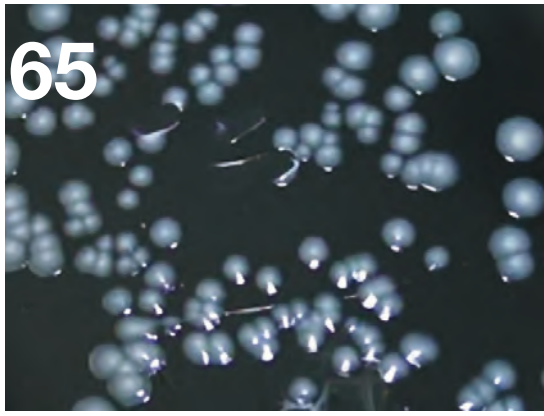

Cover: 2025 IHEA National Conference 2025, 26–28 May 2025, Sydney Masonic Centre

Visit the Institute of Healthcare Engineering Australia online by visiting www.ihea.org.au or scanning here →

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IHEA MISSION STATEMENT
To support members and industry stakeholders to achieve best practice health engineering in sustainable public and private healthcare sectors.

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EDITOR'S MESSAGE

I would like to introduce myself; my name is Frederick Foley, and I have the privilege of being your new Journal editor. As a retiring Hospital Engineer, this sojourn into the world of publishing is somewhat alien to me, so much so that I will be ably supported by fellow board member Mr Michael McCormack. Retiring editor, Mr Darryl Pitcher has left us with extremely large shoes to fill.

Darryl's passion and commitment for the IHEA and his work ethic in every role he has held, has seen the IHEA go from strength to strength and this journal is no different.

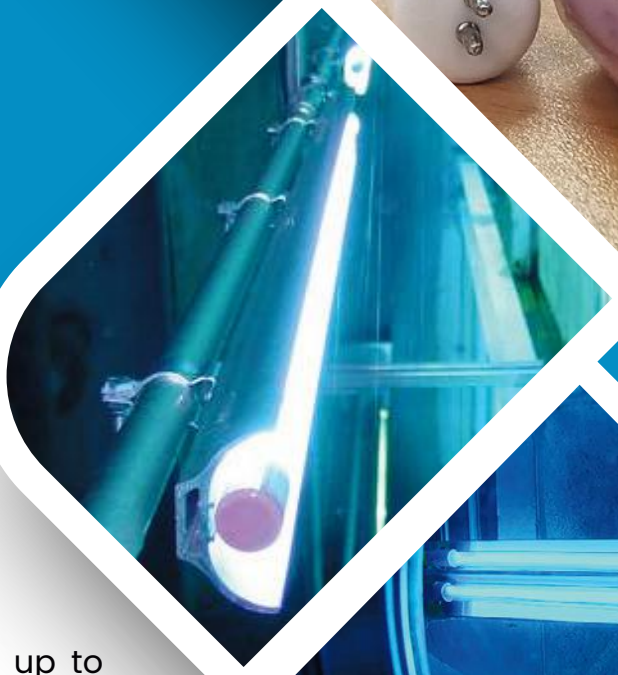
While on the subject of dedication, I would like this opening statement to acknowledge all of the hidden volunteers who make up the backbone of the IHEA. To avoid the risk of missing any individual, I will apply a broad brush. I am speaking about the past and present national board members, the local chapter executives and committee members and all of the members who help plan and run the events. Your commitment to the IHEA has been exemplary and is beyond reproach, without your contribution week in and week out the IHEA just could not be and cannot be sustained.

On behalf of every reader of this journal, we sincerely thank you.

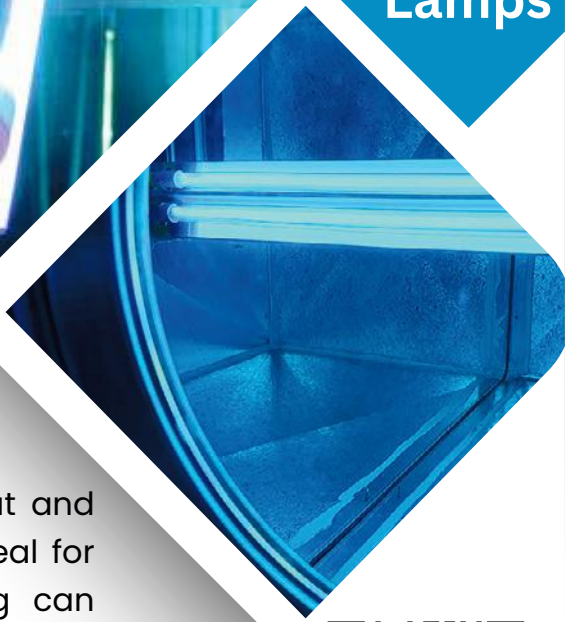
So where is the journal headed from here, well…..as Buzz Lightyear is often heard to say "To Infinity and Beyond".

Kindest regards
Fred Foley – Editor

WE USE BIGGER BULBS



T6 Lamps



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NATIONAL PRESIDENT'S MESSAGE

"…*I love a sunburnt country,*
A land of sweeping plains,
Of ragged mountain ranges,
Of droughts and flooding rains.
I love her far horizons,
I love her jewel-sea,
Her beauty and her terror -
The wide brown land for me!..."
My Country, Dorothea Mackellar

Dorothea's famous poetry goes on to say "*For flood and fire and famine, She pays us back threefold*" – little consolation for those recently affected by floods, cyclones and driving rain in New South Wales and Queensland and ongoing drought across most of central and southern Australia. In a broad land of stark contrasts, while our nation family so often pulls together and responds in the toughest of circumstances, our hearts remain with all those affected.

At times like these, while our healthcare professionals respond, the facilities they use to deliver their good work need to rapidly recover and flex as well. Our members are the unsung heroes that work hard to keep our facilities online; the lights burning and the water running, while continually looking for every opportunity to make our facilities more sustainable and more efficient.

Which is why our upcoming May National Conference themed on Future Proofing Healthcare Building Systems is an event not to miss! It's the perfect opportunity to refresh, update, network, share and connect with our professionals and trades in the industry. Check out the further details in this edition – and a reminder that early bird rates end on 28 April so don't delay your registration!

As always, our hardworking member branches are busy planning a wide range of appealing and informative professional development events. And not to get ahead of ourselves, planning for the 2026 National Conference has also commenced, to be held in Queensland.

In May, I head to Antwerp, Belgium for the IFHE Council meeting and the 11th International Federation of Healthcare Engineering (IFHE) Europe conference on healthcare engineering, themed "Sustainability through innovation". Since our last Council meeting in Cape Town, the IFHE Executive has facilitated a number of working groups to develop the Federation's standing orders, including a number of new initiatives. Over the past months, Darryl Pitcher and I have served on various working groups, on behalf of IHEA. We look forward to ratifying the standing orders with the international Council and I look forward to providing further details in future editions.

Looking forward to meeting all of you again in Sydney,

Michael Scerri
National President, IHEA

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IHEA NATIONAL CONFERENCE 2025

Future proofing healthcare building systems - getting the basics right

26-28 MAY 2025
SYDNEY MASONIC CENTRE

It is our pleasure to invite you to attend the 2025 National Conference, hosted by the IHEA's NSW branch. The Conference will be held 26-28 May 2025 at the Sydney Masonic Centre.

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THE NATIONAL EVENT FOR HEALTHCARE FACILITY MANAGEMENT AND DESIGN PROFESSIONALS

WHY ATTEND?

The IHEA National Conference offers a platform to explore cutting-edge technologies, best practices and the latest trends while focusing on future proofing healthcare building systems and getting the basics right.

Through insightful sessions, interactive discussions and valuable networking opportunities, you'll leave the conference feeling inspired and ready to implement new ideas that can make a real difference in hospital engineering.

REGISTRATION DETAILS:

EARLYBIRD MEMBER REGISTRATION: $880

REGULAR REGISTRATION: $1,200

*Earlybird registrations end midnight AEST April 27 2025

Registration includes an extensive social program including pre-conference networking, trade evening drinks and gala dinner and will provide real opportunities for you to connect with facility managers and product/service providers.

Register now via www.iheaconference.com.au

DESTINATION

Sydney is a vibrant city that beautifully blends stunning natural landscapes with urban sophistication.

From the iconic Sydney Opera House and Harbour Bridge to the sun-kissed beaches of Bondi and Manly, there's something for everyone. With a thriving cultural scene, diverse dining options, and an exciting mix of outdoor adventures, Sydney offers an unforgettable experience for visitors seeking both relaxation and adventure. Whether you're exploring the bustling city centre or unwinding by the waterfront, Sydney is a place where every moment feels like a discovery.

THE VENUE

SYDNEY MASONIC CENTRE

The Sydney Masonic Centre is one of Australia's premier event venues.

Regarded as one of Sydney's most architecturally significant buildings and a prime example of the 'Brutalist' style, designed by Joseland Gilling.

The Sydney Masonic Centre is conveniently located in Sydney's bustling CBD close to multiple public transport options and parking.

CONFERENCE HIGHLIGHTS

BEHIND-THE-SCENES TECHNICAL SITE TOURS

Our popular technical tour program will be held on the afternoon of **Monday 26 May**. Choose from one of the following options, included with all full registrations:

TECHNICAL TOUR 1 – Heritage Stoneworks
TECHNICAL TOUR 2 – CleanPeak Energy - Barangaroo South Precinct
TECHNICAL TOUR 3 – Royal Prince Alfred Hospital

INSPIRATIONAL KEYNOTE SPEAKERS

ADAM SPENCER

Maths geek, comedian and author, Adam Spencer has 25 years experience in television, radio and events. He loves nothing more than growing knowledge and getting conversations started for some of the world's biggest brands and iconic Australian institutions. Get ready to laugh, learn and be challenged with one of Australia's most dynamic and engaging minds.

DR ALI WALKER

Dr Ali Walker is a specialist in human connection and a bestselling author, with a PhD in group dynamics from the Australian National University. Ali is Adjunct Faculty at the Australian Graduate School of Management (AGSM) at the University of NSW Sydney. Ali has worked with a range of government, corporate and not for profit organisations including NSW and QLD Health, Google Australia and Westpac. Ali is also a regular contributor to Australian media on issues relating to wellbeing.

MC TIM STACKPOOL

Tim is an Australian born TV and radio professional, with a CV that boasts reporting for CBS in New York, CBC in Canada, Real Radio in the UK and RTE in Ireland.

Tim was once the Chief Australian correspondent for the Canadian Economic Press. Currently, he is the regular consumer technology reporter for the Steve Price radio program on the Macquarie Media Network heard across Australia. He is also a long-time technology contributor to various specialty publications such as Australian Executive PA Magazine, Chief of Staff Magazine and AV, the magazine for the audio-visual professional. Tim is also a popular Australian narrator for Audible, Amazon's talking book platform.

SOCIAL PROGRAM

WELCOME RECEPTION

DATE: Monday 26 May

LOCATION: Exhibition Area, Banquet Hall and Marble Foyer, Sydney Masonic Centre

TIME: 5:00PM - 7:00PM

DRESS: Smart Casual

Tickets to the welcome reception are included in full registration tickets. Extra tickets can be purchased for day only registrations and accompanying partners via the online registration process.

CONFERENCE DINNER

DATE: Tuesday 27 May

LOCATION: Australian National Maritime Museum

TIME: 6:30PM – 9:30PM

DRESS: Cocktail attire

Join us for the main social function of the IHEA National Conference 2025 at the iconic Australian National Maritime Museum.

Registered attendees to the dinner are able to access the museum from 5.30pm to take a self-guided tour of the internal museum exhibits prior to dinner starting at 6.30pm.

SPONSOR & EXHIBITOR OPPORTUNITIES ARE STILL AVAILABLE!

Sponsoring or exhibiting will provide an excellent opportunity to promote your organisation and to maintain a high profile within the Health Industry. Visit **www.iheaconference.com.au** to view the available opportunities.

CONFERENCE PROGRAM

DAY ONE: MONDAY 26 MAY 2025	
2.00pm	**Optional Technical Tours** Tickets required. Delegates must have pre-registered for a technical tour. Registration for technical tours will be located in the Marble Foyer in the Sydney Masonic Centre, close to where the buses will be departing from. **Technical Tour 1** - Heritage Stoneworks **Technical Tour 2** - Cleanpeak Energy **Technical Tour 3** - Royal Prince Alfred
5.00pm - 7.00pm	**Registration Desk Open for Welcome Reception** **Location:** Marble Foyer, Sydney Masonic Centre
5.00pm - 7.00pm	**Welcome Reception** **Location:** Marble Foyer and Banquet Hall, Sydney Masonic Centre **Dress:** Smart Casual *Sponsored by Programmed Property Services*
DAY TWO: TUESDAY 27 MAY 2025	
7.00am - 5.00pm	**Registration Desk Open** **Location:** Marble Foyer, Sydney Masonic Centre
ALL CONFERENCE SESSIONS WILL BE HELD IN THE GRAND LODGE, SYDNEY MASONIC CENTRE	
8.30am	Sessions Commence MC: Tim Stackpool
8.30am	**Welcome To Country**
8.40am	**Official Conference Opening & Housekeeping**
8.45am	**Official Conference Address** Health Department - Minister or Representative
9.00am	**Official Conference Address** Health Building Authority
9.15am	**IHEA National President Address** IHEA National President
9.25am	**Gold Sponsor Address** Schneider Electric
9.35am	**KEYNOTE ADDRESS** Adam Spencer *Sponsored by Mitsubishi Heavy Industries*
10.30am - 11.00am	**Morning Tea & Exhibition**
11.00am	**Victorian Health Building Authority's Digital Engineering Framework: Simplifying Asset Information for Effective Project Handover** Paul Morgan, Victorian Health Buidling Authority
11.20am	**Future-Proofing Healthcare Infrastructure: The Role of Data Standardisation and the VBIS Standard in Digitisation** Nathan Semos, Virtual Buildings Information System (VBIS)
11.40am	**Transition from AS/NZS 3439 to AS/NZS 61439: A Comprehensive Analysis of Risk Transfer Dynamics Between Stakeholders** Will Davies, Alight Consultants
12.00pm - 1.00pm	**IHEA Annual General Meeting**
12.00pm - 1.30pm	**Lunch & Exhibition**
1.30pm	**Electrification of Hospitals: Challenges Faced and Lessons Learnt** Shihan Fernando, LCI Consultants
1.50pm	**Transformation of Hertiage Building into Tissue Pathology and Diagnostic Oncology Lab** Meenal Sharma, Slhd
2.10pm	**Future-Proofing Healthcare Safety: Simplifying Emergency Lighting With Hybrid Photoluminescent Exit Signs** John Biondo, Polar Enviro
2.30pm	**Future Proofing Old and New Day Procedure Buildings: Getting the Basics Right** Sandy Thomson, GovernancePlus
2.50pm	**Anticipating Future Needs in Airborne Infection Control Within Healthcare Facilities** Patrick Chambers, Stantec
3.10pm - 3.40pm	**Afternoon Tea & Exhibition**

3.40pm	**New Insights into the Management and Design of Water Systems to Prevent Healthcare Associated Infections** Dr Harriet Whiley, Flinders University
4.00pm	**Legionella and Beyond: The Complex Interplay Between Water Hygiene and Corrosion in Healthcare Building Systems** Dr Surani Mccaw, Southland Filtration
4.20pm	**Point of Use Disinfection for Potable Water Systems** Scott Goulter, Genaqua Pty Ltd
4.40pm	**Conference Sessions Conclude**
6.30pm - 9.30pm	**Conference Dinner** **Location:** Lighthouse Gallery, Australian National Maritime Museum *Sponsored by Enware*
DAY THREE: WEDNESDAY 28 MAY 2025	
8.30am - 3.15pm	**Registration Desk Open** **Location:** Marble Foyer, Sydney Masonic Centre
9.00am	**Day 2 Welcome & Housekeeping**
9.05am	**Gold Sponsor Address**
9.15am	**KEYNOTE ADDRESS** Dr Ali Walker
10.15am - 10.45am	**Morning Tea & Exhibition**
10.45am	**Understanding Current Practice: Legionella Risk Management in Premise Plumbing Systems** Hao Wi, College of Science & Engineering, Flinders University
11.05am	**Smart Water Analysis Driving Safer and Sustainable Hospitals** Jason Hinds, Enware
11.25am	**Methods Used for Preventing Copper Pipe Corrosion (Including Case Studies)** Mark Collen, Cetec
11.45am	**Asset Management in Healthcare Facilities: Optimising Lifecycle Cost Forecasting and Ensuring Regulatory Compliance** Dr Seyed Safi, Covaris Pty Ltd
12.05pm	**Resilience: Future Proofing Facilities With an All-Hazard Approach** Jordan Barltett, Proactive Design
12.25pm - 1.25pm	**Lunch & Exhibition**
1.25pm	**Future-Proofing Healthcare Building Systems: Getting the Basics Right in Emergency and Exit Lighting** Michael Goodman, Clevertronics
1.45pm	**Combining the Real and Digital Worlds: Case Study Demonstrating Benefits From Digital Lifecycle Twin Deployment at a Major Melboure Hospital** Anthony Guiragossian, Siemens Ltd
2.05pm	**Designing Safe, Accessible and Inclusive Heathcare Precincts** Alice Vincent, Arup
2.25pm	**From Helipads to Generators to Main Roads: Treating Combustion Exhaust Odours in Healthcare Facilities** Ben Gill, Plasma Shield Ltd
2.45pm	**Are Your Assets/Services Critical or Risky? How do you know?** Keith Paintin, Lucid Consultancy
3.05pm	**2026 Conference Presentation**
3.10pm	**Conference Close & Prize Draws**
3.30pm	**Conference Concludes**

CONTACT THE CONFERENCE ORGANISERS

ICEBERG EVENTS **Phone:** +61 7 3876 4988 **Email:** amy@icebergevents.com.au

Subscribe to event updates at **www.iheaconference.com.au**

This program is an outline only and the organisers reserve the right to change the topics, times and presenters if necessary. For the most up-to-date version of the program, view the conference website www.iheaconference.com.au

Queensland Branch Report

The December festivities probably feel like a distant memory for many, but I hope everyone had a great time celebrating Christmas and the New Year. School holidays and Easter are just around the corner, and we find ourselves already one quarter of the way through the year!

Whilst summer is officially long gone, its heat and humidity linger, and it feels like a slow start to autumn. The past few weeks have been a worrying time with floods in far north Queensland, Cyclone Alfred wreaking havoc in the southeast, and as I write this, there is a potential for further flooding up north. Whilst the damage from the cyclone was not as extreme as predicted, flooding and wind damage were experienced by many in Southeast Queensland and especially in northern New South Wales. For everyone who has experienced hardship through all these events, I would like to extend my sympathies and my hope that you are back on your feet as soon as possible.

The Queensland committee has been busy planning and running the March PD, planning for the midyear conference, and working with Iceberg to plan for the National Conference in 2026. It is shaping up to be a full year.

Afternoon Professional Development Seminars

Our PD on 13 March at the Pineapple Hotel was very well attended with approximately 60 attendees joining us for very informative and interesting sessions followed up with networking drinks. NHP kindly sponsored the event and spearheaded the presentations, with Jeff Davies first sharing from his vast experience. Jeff shared the importance of properly designed and constructed switchboards and switchboard rooms to ensure reliable and safe supply of power in our health facilities. Whilst it is at times a struggle to justify the expenditure due to constrained budgets, his presentation was a great reminder of the need to get the basics right (those protracted negotiations and meetings are worthwhile) and set the foundation for switchboards that provide many years of reliable service. Conrad VanRooyen (Hexeis Energy Pty Ltd) and Charles Webster (CR Webster & Associates Pty Ltd) followed up with a joint discussion on their experiences with ensuring reliable supply through robust switching, taking advantage of the tested imbedded software of switching systems and the benefits of using available information for predictive maintenance. Lachlan Pringle (NHP) rounded out

the afternoon focusing on the benefits of switchgear that is specifically designed for the intended purpose.

Please keep an eye out for information that will be forthcoming via emails and as published on the IHEA website for the next PD planned for November.

Midyear Conference, 31 July 2025

Please keep your diaries free for the Queensland midyear conference on Thursday 31 July. After the successful conference last year, the Brisbane Convention and Exhibition Centre has been booked - a larger space has been secured to meet all the interest that has been expressed. Please consider joining us to help make this midyear conference the best we have ever held.

The theme of the conference is currently being finalized - If you are interested in sponsoring or have any burning topics you would like to hear more about (or to present on) please contact. the team

Committee of Management (COM)

Again, nothing happens without the assistance and support of the COM. After many years on the COM, Arthur Melnitsenko has stepped down and I would like to thank him for all his hard work, especially his invaluable contribution in rounding up the sponsors for our mid-year conferences. We look forward to catching up with him at our events.

President	Danny Tincknell
Vice President	Michael Campbell
Treasurer	Michael Ward
Secretary	Josiah Padgett
State National Board Rep	Nic Coffey
Committee member	Christopher Aynsley-Hartwell
Committee member	Mark Fasiolo
Committee member	Mark Collen
Committee member	Adrian Duff
Committee member	Liam Duller
Committee member	Linda Jordinson

If you would like to communicate with the QLD Branch via email, please do so at ihea.qld@ihea.org.au . We would greatly appreciate feedback on our events and welcome any ideas for topics that you are especially interested in.
Wishing you all a safe and happy Easter.

Danny Tincknell
President, QLD Committee of Management

VIC/TAS BRANCH NEWS

The Victoria / Tasmania Branch can highly recommend the monthly 'lunch + Learn' one-hour professional development sessions for 2025.


Michael Goodman

We are also pleased to welcome a new member, Mr Michael Goodman, Clevertronics Senior Key Accounts Manager - End User Property and Asset Upgrades to the Victoria/ Tasmania Branch Committee of Management.

Michael is an accomplished professional in the field of building services systems, with a career spanning several decades. He began his journey in this domain with the successful delivery of his first major project in 1995, designing and commissioning the building control systems for St Vincent's Hospital in Melbourne.

In 1995, Michael played a pivotal role in implementing advanced control systems at St Vincent's Hospital Melbourne, enhancing the hospital's operational efficiency and patient care services. This project marked the beginning of his commitment to integrating technology with healthcare infrastructure, setting a standard for future developments in the sector.

Throughout his career, Michael has continued to contribute significantly to the advancement of integrated building systems within healthcare and other industries, consistently demonstrating expertise and dedication to improving technological frameworks.

In his role at Clevertronics, Michael harnesses Clevertronic's long history of world leading innovations and technology to reduce the burden of emergency and exit lighting compliance across health portfolios. He achieves this by optimising maintenance and lifecycle management while improving operational efficiency and addressing the challenges associated with carbon reduction in our buildings.

https://www.linkedin.com/in/michaeljohngoodman/

Michael will be well known to many IHEA members as a strong supporter of our members and through Clevertonic's National conference sponsorship. We look forward to Michael's contribution to the Vic/Tas branch.

BRANCH ACTIVITIES

***Master Class, Lunch & Learn – 37 attendees - Ultraviolet Germicidal Irradiation Technology Systems in Building HVAC Systems, Wednesday* 26 February 2025**

Great presentation by Jason Vecchio and Sankha Senanayake of Opira Group, outlining the fundamentals of UVGI technology and its installation in Sanuvox UVGI systems. Opira Group is here to assist in paving the way for cleaner air and a healthier community.

Indoor air quality (IAQ) is now a top priority as individuals spend 90% of their time indoors. Traditional HVAC systems focus on temperature, humidity, and basic air quality metrics such as carbon dioxide and VOCs. Advanced filtration, and germicidal UV light (UVGI). UVGI is a game-changing technology capable of inactivating microorganisms without disrupting airflow or relying on chemicals.

LOOK AHEAD ACTIVITIES

Water quality system approaches both the legionella risk management along with the other HAI implications

- Storing and handling dangerous chemicals - CTEC
- Evacuation plans - EvacPlans
- Lesson learnt following the Pandemic. What worked well etc. Focus on ventilation and HVAC systems. What we are seeing an emerging themes following the Pandemic from a IPC and ID overlay
- Site tour / meeting - Clevertronics factory / training facility
- Site tour / meeting - Austin Hospital (IoT and others new products in Vic market): with the support of Austin Health in conjunction with Ventia. The tour will include:
- IoT sensors working on pumps, fans, motors, The IoT sensor supplier will complement our presentation.
- Medical Air compressor skid in AT B3 from BeaconMedaes, Atlas Copco Australia. The equipment supplier will complement our presentation.
- Smardt Chiller No 5 in LTB Podium L4. The equipment supplier will complement our presentation.

VALE Sergio Adofaci

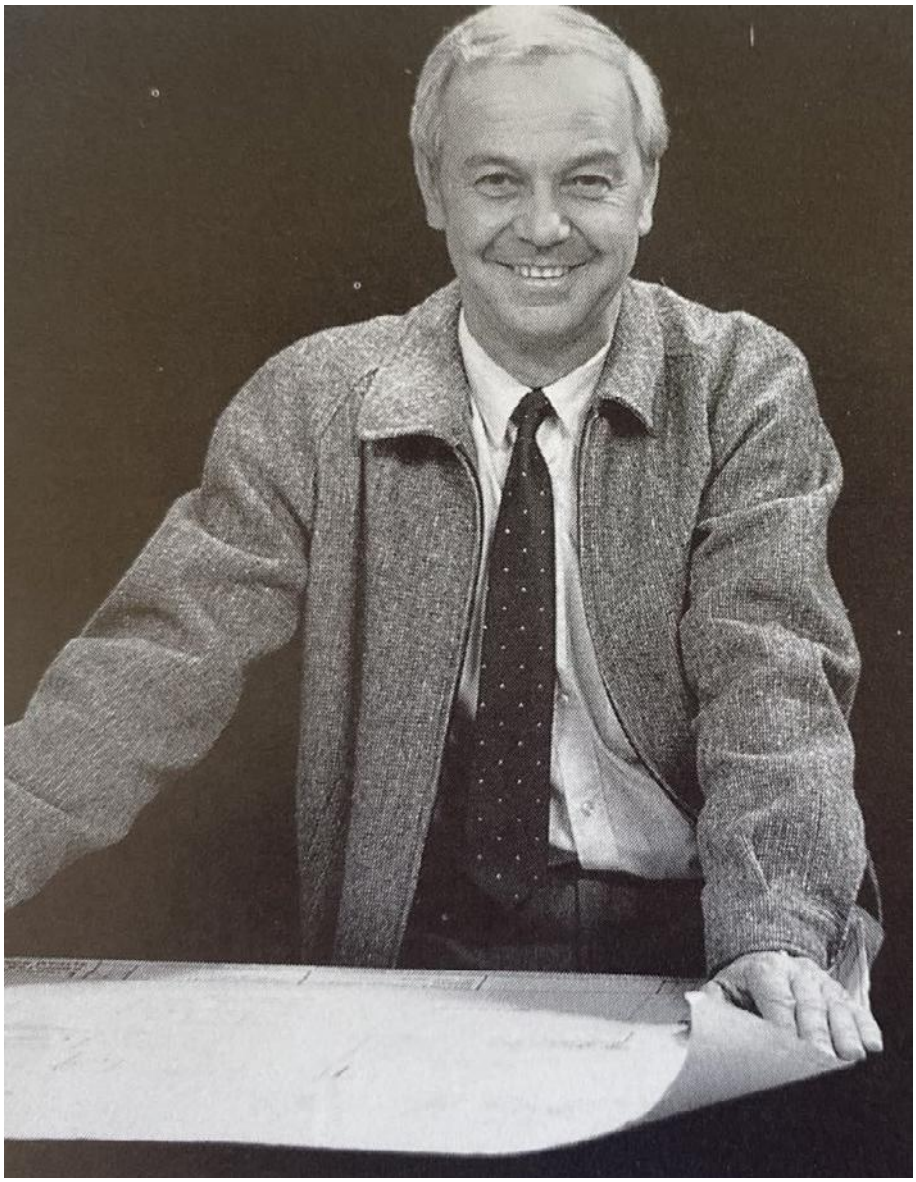
It is with great sadness that we farewell Victoria / Tasmania Honorary Fellow Sergio Adofaci. Sergio was a member for 52 years having joined the IHEA on June 21st 1973. Sergio held many roles during his time with the IHEA including tenures on the local chapter Committee of Management, National Board Member and National President. Sergio was well known and respected by the IHEA and International Federation Hospital Engineering members. Sergio will be missed and we send our sincere condolences to Sergio's family.

BRANCH COMMITTEE of MANAGEMENT 2025

Branch President/Board Rep	Michael McCambridge
Treasurer/Board Rep	John Mihalinac
Committee member	Steven Ball
Committee member	Pablo Perez-Reigosa
Committee member	Michael Goodman

Michael McCambridge
Vic/Tas State Branch President

OBITUARY
Sergio Adofaci 1939–2025



Sergio Adofaci passed away at the Austin Hospital, Heidelberg on 22 February 2025 at the age of 85.

Sergio was a long-standing and prominent member of the Institute of Hospital Engineering Australia. He was for over 50 years a strong supporter of and advocate for the Institute and was a past President. He was also a Councillor of the International Federation of Healthcare Engineering.

Having graduated from the Merchant Navy College in Genoa, Italy, he pursued a successful career as a Marine Engineer before settling in Melbourne in 1966 at the age of 27. After a short stint with the Port of Melbourne tug service he found employment as Deputy Engineer with the Kingston Centre Hospital for the Aged in Cheltenham, Victoria.

In 1971 Sergio became the Director of Building and Engineering Services of the Preston & Northcote Community Hospital, a role he fulfilled until 1993.

Following his resignation from PANCH Sergio became a sought-after expert advisor on healthcare facilities engineering services and infrastructure.

As a member of the MACE Consulting Group team, he was involved in the review of the engineering services at the Commonwealth Serum Laboratories (Plasma Division) and the establishment of a preventive maintenance system for their plant and equipment.

This was followed by his engagement by the Austin Repatriation Medical Centre for the review of staffing levels of Building & Engineering Services and the conversion of 4mW briquette fired boilers to unattended code AS2593-1995.

Following the establishment of S&K Adofaci Consulting in 1996, Sergio worked extensively as a sub-consultant to Capworks Management (Qld) P/L on the preparation of healthcare facilities' condition surveys, strategic maintenance plans and capital expenditure plans for the Queensland Health Department, the South Australian Health Department and private healthcare providers.

During his time at PANCH Sergio became lecturer in a course for Engine Drivers and Boiler Attendants at the Royal Melbourne Institute of Technology in his spare time. After RMIT discontinued the course, Sergio continued to provide training for manufacturing organisations who needed legally qualified staff to operate their steam plants. This service eventually expanded to include international clients in the Middle East and continued until Sergio's retirement in 2014 at the age of 75.

Throughout his long working life Sergio established a reputation of integrity, hard work and reliability. But to those who had the privilege to know him, his larger-than-life personality, his sense of humour, his ability to make friends and to light up the space around him are Sergio's outstanding qualities that we will remember most.

Bill Geerlings, CHENG (UK), FIHEEM, FIHEA, BHA(UNSW).
Melbourne, March 2025.

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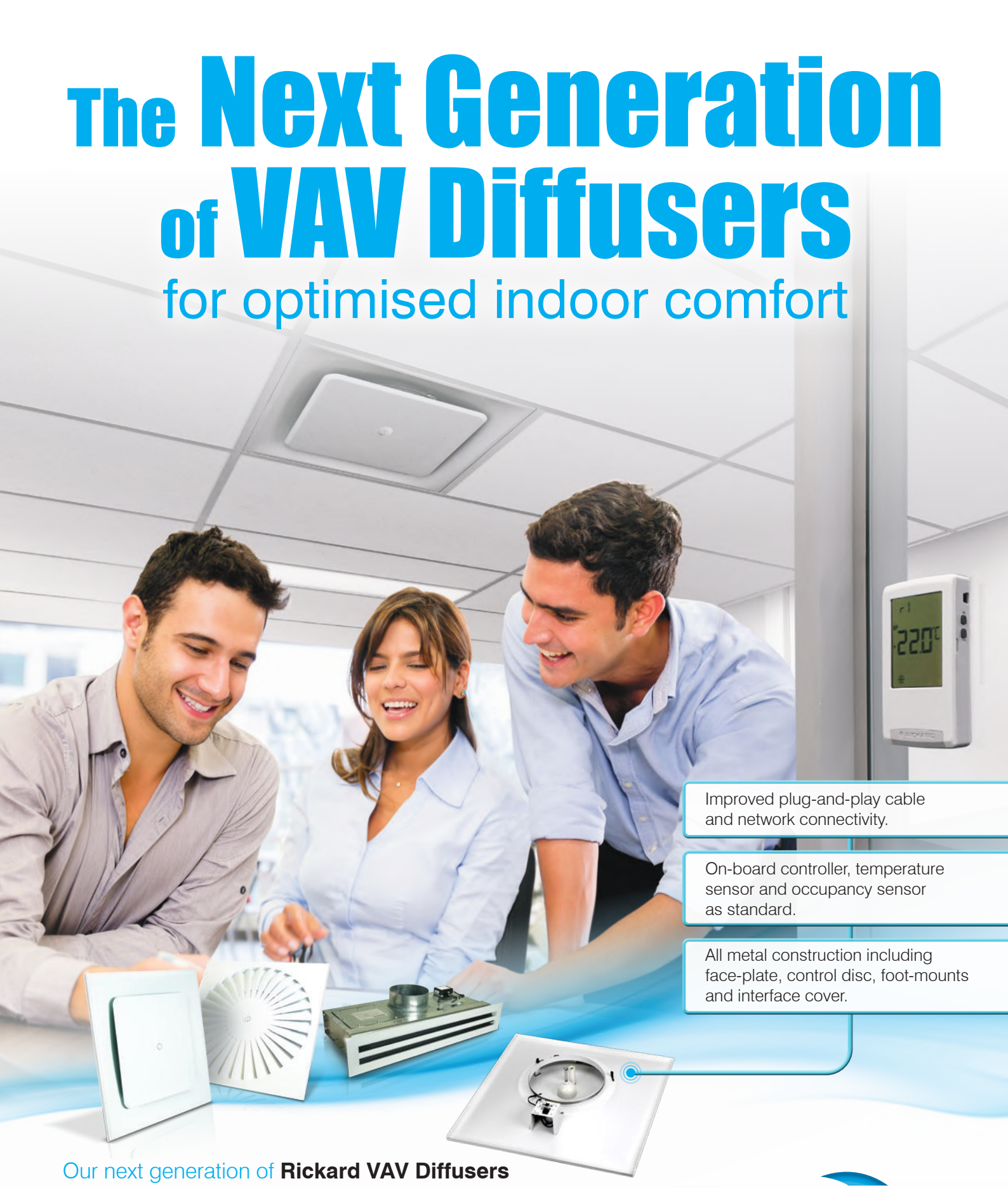

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NSW/ACT BRANCH NEWS

Greetings from the NSW/ACT branch and I hope you all had a good break over the Christmas/holiday period. For those who were left to hold the fort, I hope it wasn't too hectic.

In NSW, we have a busy period coming up in May 2025.

Commencing on Thursday May 8th 2025, we will be hosting the IHEA NSW/ACT Branch Charity Golf Day at the Ryde/Parramatta Golf Club.

The day is all about raising money for Backpack beds for the Homeless. The funds raised directly support the Backpack Bed program and Sleeping Bag Hypothermia Packs, which saves lives on the streets. This will be a great day for networking, having a bit of walk/ hit around the park and also supporting a great charity that has real results and impacts. Hope to see you there.

Next we will be hosting the IHEA National Future Proofing Healthcare Building Systems Conference at the Sydney Masonic Centre, 66 Goulburn Street, Sydney.

The conference commences at 9am (AEST) on Monday 26th May 2025 and continues through to the afternoon of Wednesday 28th May 2025.

The conference program includes keynote speakers Mr Adam Spencer and Dr Ali Walker, technical site tours, a sponsors trade show / welcome drinks, a myriad of plenary sessions culminating with a sumptuous conference dinner and pre-dinner tour of the National Maritime Museum.

It is looking to be an excellent event, so I am encouraging you to jump onto the web site and secure your early bird tickets.

There will be a number of expert presenters delivering papers spanning a broad range of industry subjects plus a variety of trade booths, so if you have an issue, a problem or just want to have a casual conversation about something, I guarantee there will be the right person to have a chat with.

The event is being held in the middle of the Sydney CBD, right next to the light rail and Central Station granting easy access to all the great sites of Sydney and the airport. China Town is just a short 150m away and the light rail can whisk you straight to Circular Quay with the Sydney Harbour Bridge, Opera House and the famous Sydney ferries at your fingertips. Visit the Centre Point tower and get a panoramic view of Sydney and surrounds, then walk down to the Botanical Gardens right on the Harbour and then an easy stroll to the Opera House for a beverage at the famous Opera Bar. There are plenty of shows, concerts, bars and restaurants to entertain you, so why not bring your partners and family and make life time memories.

The IHEA is an organisation that relies on its members to come together to keep these events viable for our supporters, so if you can spare a moment or two to spread the word about the IHEA and the National Conference across your organisation about who we are and the benefits of attending these events.

Looking forward to catching up with you in Sydney.

Moving forward, we will be organising more events, PD days and online forums for NSW/ACT. If you have any topics you would like to address or sites you would like to visit, drop us a message to ihea.nswact@ihea.org.au .

Cameron Ivers
NSW/ACT Branch President.

WA BRANCH NEWS

Summer is over and it is autumn once again, the seasons just seem to fly by nowadays. Maybe it has something to do with our hectic lifestyle, always having to be somewhere to do something that just cannot wait. One legacy of healthcare engineering is that there never seems to be enough time to stop and smell the roses, that is unless you actually step off the ride for a moment or two to take that well-earned breather.

Our national conference rotates through all of our nation's capitals, and one trick I use to take a break is to combine the IHEA National Conference with a holiday. That way, I get to enhance my professional career, spend networking time with my colleagues and most importantly, spend time with my family touring this wonderful country of ours. Try it sometime, you and your significant others will be the better for it. The Sydney conference is rapidly approaching, and it looks like being a cracker of an event. Check it out, if you haven't already.

Looking locally at our activities over this past summer, nothing much has really happened. I temper this by adding that the WA chapter takes the whole of January off. Our first event being scheduled for some time in February. 2025 was no different. If you are an avid reader of the journal, you may recall that our summer submission was packed with activities culminating with our Christmas Sundowner and Awards evening. Following on, our February event was scheduled to be an overview of the pending resurrection of the suspended Australian Standard AS 3811 Hard wired patient alarm systems. We all know that there are no certainties in life, the consultants had to reluctantly postpone their presentation due to the small matter of the standard not being ready to be published. A tiny inconvenience as there are quite a few Health Facility Managers in Western Australia eagerly waiting for this standard to reappear. One hopes it will reinsert some logic and reliability back into our patient alarm systems, something that has been missing since these systems went digital.

IHEA Committee Member and avid supporter, HPM manager Mr David Chokolich, put up his hand to host a professional development session on Asset management. He did apologise to the attending group of 30 members and guests that due to the lack of preparation time not to expect too much. Well if what David and his team produced was any indication of what they can do at short notice, I must

HFM Consultants

Mr David Chokolich

Members settling in

The BOC pre start meeting

attend one of their events when they have had the requisite preparation time frame.

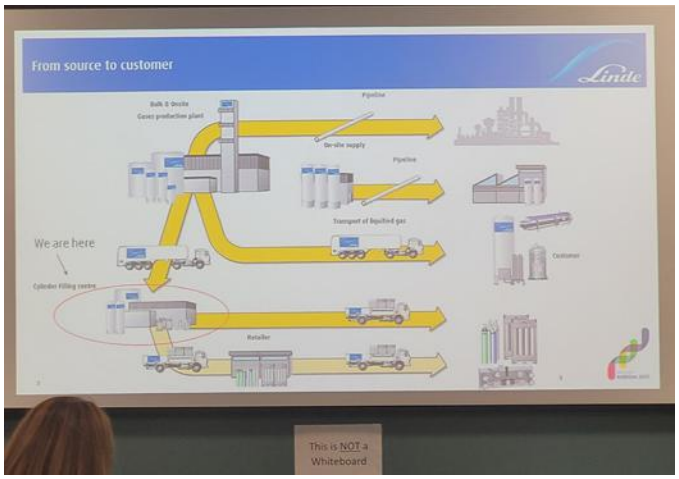
Asset management is a passion of mine and is often a forgotten facet of not only Healthcare Facility Management but in fact the Facility Management of many organisations. The introduction and subsequent enforcement of Western Australian new WHS laws and regulations sees many senior executives looking to their Facility Management teams to give assurances that the organisations they are in charge of are compliant and safe.

David's presentation delivered this message cleanly and succinctly. Some of the attending delegates proudly advised that their organisations have already been accredited to the AS55000 standard. Though costly, the commitment of funding and effort is cheap insurance. The ensuing conversations focussed on the changing asset management environment and the subsequent challenges Facility Managers are now faced with.

David and the HPM team have opened the gate for more professional development sessions on Asset management. Our thanks go to David and his team for hosting a great opening event for 2025, even if it was "at short notice".

The evening of Thursday March 20th saw 35 members and guests meet at BOC's Canningvale site for a tour of their medical gas facility. Many years ago, the IHEA WA chapter

The production floor



The process simplified

BOC Hospitality

The BOC Team plus 1

partnered with BOC, together with some of the state's leading medical gas contractors and anaesthetists to host a series of professional development events on the medical gas production to patient process. Many of those medical gas contractors have either ceased trading or changed ownership, added to the number Healthcare FM Managers retiring, it was time to introduce the new generation of Healthcare Facility Managers, Asset Managers, Consultants, Project Managers and Contractors to the nuances of this often underestimated but critical life support system.

The BOC team treated the attending delegates to an informative evening. Safety first is paramount with BOC, and after the mandatory pre start safety meeting, the delegates were split into manageable groups then escorted through their Canningvale facility.

On returning to the meeting room we were treated to a detailed and comprehensive explanation of the complex process of extracting the gases from the air we breathe. That in itself would have been sufficient but there was more. We were treated to an excellent presentation of the medical gas maintenance process and the rationale behind the changes to the standards. We were shown examples of typical medical gas installations highlighting the inherent dangers of not upgrading to the new standard. I am sure this will raise a few conversations in Facility Management forums.

With the formalities completed we retreated to their canteen for a period of networking and hospitality. From my interactions with the delegates, the evening was an overwhelming success. Our thanks go to the BOC team.

On Thursday April 10 we will gather at the RAAF Museum in Leeming Western Australia. If you love aircraft, this is one event you do not want to miss.

May is National Conference month and for those who cannot afford the journey eastward. We are hoping to schedule an event early in May. Keep a watch on the IHEA website for more details.

Frederick Foley
Editor, IPP and National Board Member.

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COMPRESSED AIR IN THE PHARMACEUTICAL INDUSTRY

Kaeser

The extensive automation characteristic of modern production methods in the pharmaceutical industry makes compressed air a vitally important energy carrier. Supply failure can result in expensive downtime whilst inefficiencies in production and distribution can mean unnecessarily high costs. As a whole, this series illuminates design and implementation principles for ensuring an efficient, reliable and cost-effective compressed air supply – which is often possible without major effort. Below, Part I provides an overview and introduction to topics covered in more detail in the following parts accessible via the link at the end of the article.

Introduction

Maximum availability paired with energy efficiency and cost effectiveness over the entire life-cycle represent the main requirements for a compressed air supply system.

Energy consumption and cost analysis, cost planning and ongoing management, as well as permanent optimisation based on actual circumstances: these are indispensable to any cost-effective and reliable system. Innovative products and services recently launched on the market significantly facilitate the realisation of these key features whilst also ensuring that the compressed air supply is capable of accommodating future developments – provided several key points are taken into account.

Compressed air is used widely throughout the pharmaceutical industry, beginning with processes and transport of pharmaceutical materials, through to packaging and use in medical devices. The huge variety of different requirements and individual design options characteristic of each production operation makes it impossible to make a one-size-fits-all final recommendation.

Major differences are evident simply in the floor plans and usage of space: different production sites are distributed over large areas, some housed in one or more buildings, whilst others may be meticulously planned in advance or the result of organic growth over time. Yet all share one commonality: an individual approach must be taken in each case.

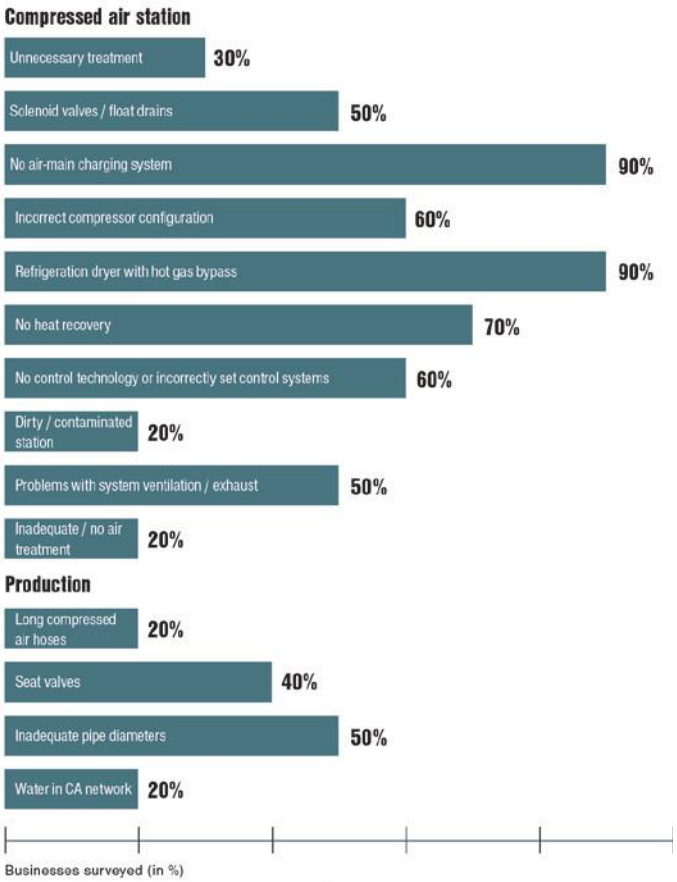

Image 1: Inefficiencies in compressed air stations and production areas

This plethora of possible differences results in each case having widely differing weak points and cost drivers (Image 1). Thanks to some basic criteria, however, reviewing, and even improving, one's own system is easy to accomplish. When produced under unfavourable conditions, compressed air can be very expensive; yet when the right framework is provided, compressed air can be extremely cost-effective.

Analysis: the first step

Although the ideal situation is to plan a completely new compressed air supply from the ground up, it's more common for existing systems to be assessed and optimised where possible.

In either case, nothing meaningful can be accomplished until an Air Demand Analysis has been performed – and this often presents the first stumbling block. Despite the significant progress achieved in compressed air technology in recent years, only a fraction of compressed air system operators actually know this crucial value in relation to their own system.

In a "mature", running pharmaceutical operation, compressed air often remains a process element that's simply "just there" and doesn't necessarily garner any further attention. Yet it's precisely companies that have grown over time whose compressed air systems often harbor dramatic potential cost savings. These savings can be achieved in several different areas:

1. Optimal adaptation and layout of the compressed air system based on the company's actual needs
2. Energy cost reductions through the use of low-consumption, highly efficient components, and
3. Optimisation of monitoring and service provision over the entire life-cycle of the compressed air system.

Today, any business planning a new compressed air supply or renovating its existing one absolutely has to have the overall concept in mind, as well as the system's continuing viability into the future.

Compressed air systems have a long average service life of some 20 years and are often used every single day. Some investments that may appear attractive over the short term can turn out to be very expensive in the long run. On the other hand, higher initial investment often pays for itself rapidly, then goes on to yield cost advantages year after year.

As a general rule, relatively high potential savings can be achieved through optimisation of compressed air systems. According to studies, savings ranging between 10 and 70 percent of energy costs can be achieved – regardless of the condition of the existing system (Image 2).

A compressed air system comprises more than just the station itself; it's rather like a chain, as in the case of electricity generation. In relation to compressed air, the chain begins with compressed air production, followed by treatment and distribution, and ends with the compressed air user. The whole chain must work synergistically to achieve the most cost-effective compressed air supply (Image 3).

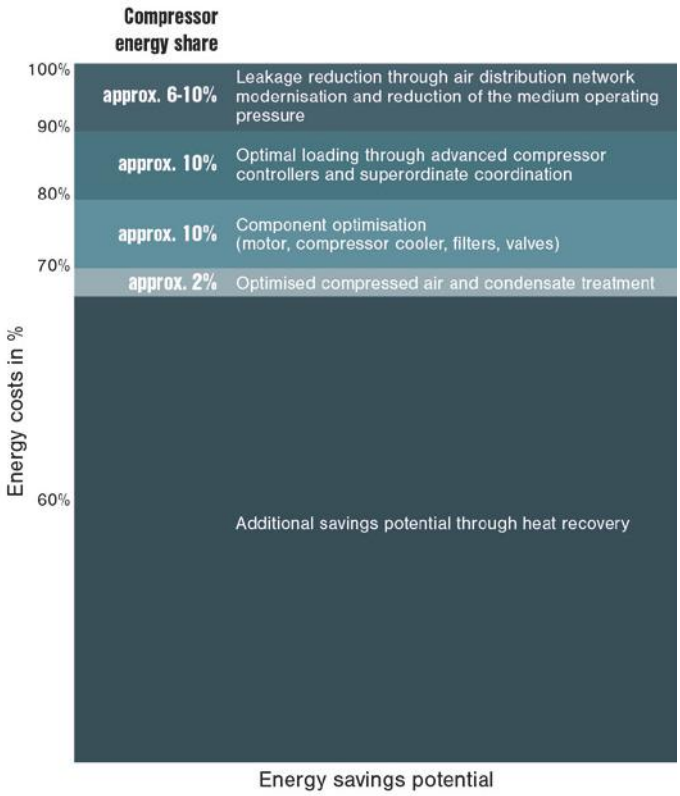

Image 2: Compressed air production savings potential

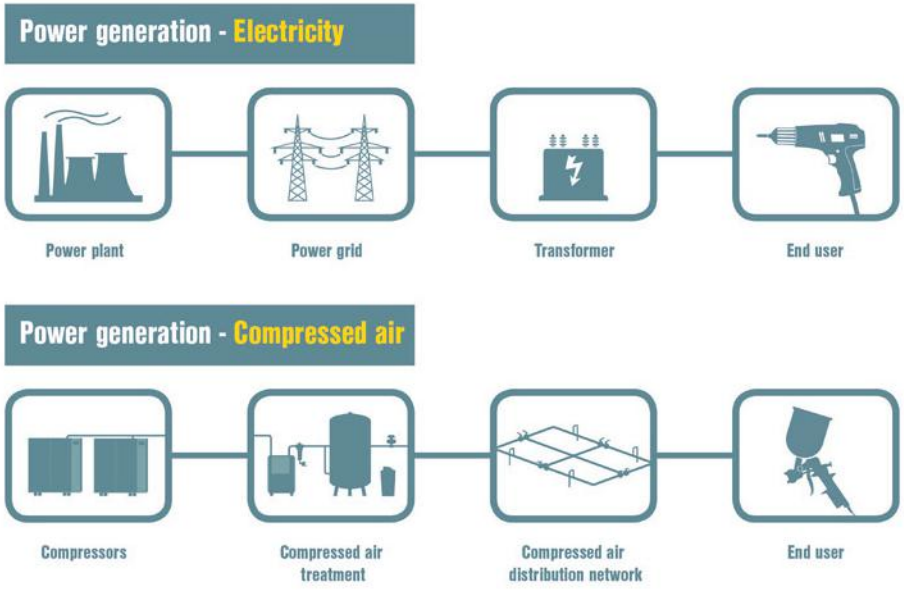

Image 3: The whole chain must work synergistically to achieve the most cost-effective compressed air supply

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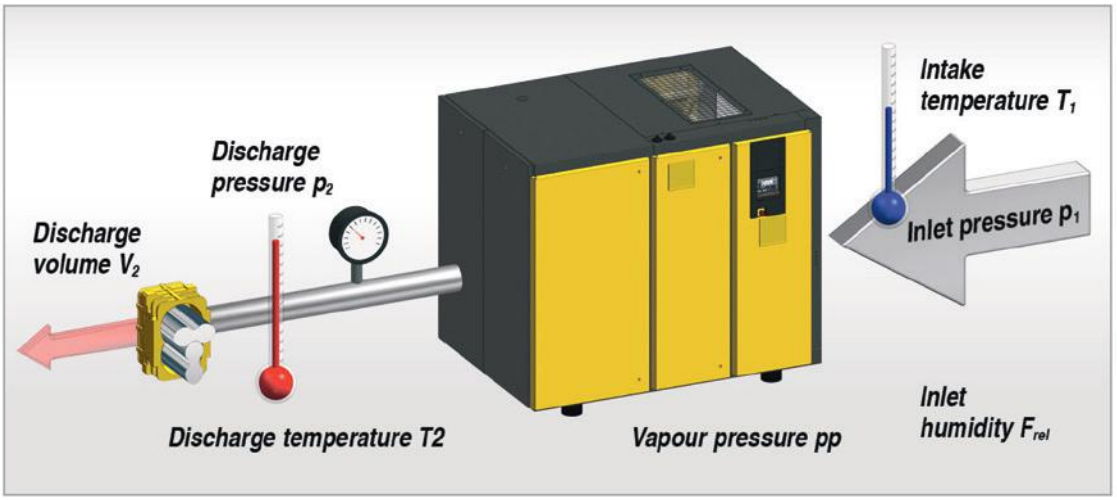

Image 4: Planning new systems and renovating existing ones becomes much easier when the key terms and values are known.

Since in most cases the compressed air required in the pharmaceutical industry must be highly pure, achieving synergies becomes especially important in this sector in particular, since compressed air loss or potential contamination can occur at all points along the chain. There's no point in having the compressed air station produce top-quality compressed air unless this high quality level can be maintained throughout the downstream distribution network and by the end consumer. Ideally, optimised production, appropriate treatment, suitable distribution and constant monitoring go hand in hand.

Assessing quality requirements

In pharmaceutical industry applications, compressed air generally functions as a process medium – rarely a medication. ISO Standard 8573-1 therefore forms the basis of quality requirements as it establishes compressed air quality classes as well as the measurement methodologies to be applied in each case. Several other frameworks also play a large role in the pharmaceutical sector, including Government and industrial recommendation and standardisation.

Definition of terms

The first step in an analysis is to answer some fundamental questions, which are explained in detail below. To aid in answering them as correctly as possible, some key terms and standards in the field of compressed air technology are provided here, along with their meanings and any other important information.

1. Flow rate

The flow rate of a compressor is the expanded volume of air it forces into the air main (network) over a given period of time.

The correct method of measuring this volume is prescribed by Standard ISO 1217, Annex C. As shown in Image 4, the measurement process is performed as follows: the temperature, atmospheric pressure and humidity must first be measured at the air inlet of the compressor package. Then, the maximum working pressure, temperature and volume of compressed air discharged from the compressor are measured. Finally, the volume V2 measured at the compressed air discharge port is referred back to the inlet conditions using the equation shown (see formula).

The result is the flow rate (V1) of the compressor package. This value is not to be confused with the airend flow rate (or block flow rate, in reciprocating machines).

2. Motor shaft power

The motor shaft power is the power that the motor delivers mechanically to its output shaft. The optimal value for motor shaft power lies within the range of the rated motor power. The rated power is shown on the motor's nameplate.

$$V_1 = \frac{V_2 \times P_2 \times T_1}{[p_1 - (p_D \times F_{rel})] \times T_2}$$

Note: If the motor shaft power deviates too much from the rated motor power, the compressor will run inefficiently and/or will be subject to increased wear.

3. Electrical power consumption

The electrical power consumption is the power that the drive motor draws from the mains power supply with a defined mechanical load on its shaft (motor shaft power). The power consumption exceeds the motor shaft power by the value of the motor losses – both electrical and mechanical – from bearings, fan, etc. The ideal electrical power consumption P can be calculated using the formula:

$$P = U_n \times I_n \times \sqrt{3 \times \cos \varphi_n}$$

U_n, I_n, and $\cos \varphi_n$ are listed on the motor nameplate.

4. Specific power

The specific power of a compressor is the relationship between the electric power consumed and the compressed

air delivered at a given working pressure. The electrical power consumption is the sum of the power consumed by all consumers in a compressor, for example, drive motor, fan, oil pump, auxiliary heating, etc.

If the specific power is needed for a cost-efficiency assessment, it should refer to the compressor package as a whole and the maximum working pressure. The overall electrical power consumption at maximum pressure is then divided by the flow rate at maximum pressure:

$$P_{spec.} = \frac{\text{Electrical power consumption}}{\text{Delivery}}$$

5. IE – The new formula for energy-saving drives

Efforts in the USA to reduce the energy requirements of three-phase asynchronous motors resulted in the Energy Policy Act (EPACT) becoming law in 1997. A short while later, an efficiency classification system was also introduced in Europe.

The international IEC standard for electric motors has been in place since 2010. Classifications and legal requirements subsequently resulted in significantly improved energy efficiency for premium class electrical motors. High efficiency motors provide significant advantages:

a) Lower operating temperatures

The internal efficiency loss caused by heat generation and friction can be as high as 20 percent in small motors and 4-5 percent in motors upward of 160 kW.

IE3/IE4 motors operate with significantly less heating and, as a result, with much lower losses (Image 5).
A conventional motor with F class insulation operates at about 80 K, giving it a temperature reserve of 20 K, whereas an IE motor, working under the same operating conditions, will run at only about 65 K, increasing its reserve to 40 K. Manufacturers of modern compressors now often equip their units with IE4 motors because they deliver the best efficiency values and importantly, compatibility with future developments.

b) Longer life

Lower working temperatures mean less thermal stress on the motor, motor bearings and terminals. Motor service life is significantly extended as a result.

c) More compressed air with less energy

Less heat loss leads to increased efficiency. Thus, with precise matching of the compressors to the enhanced efficiency motors, leading compressor providers are able to offer significant increases in flow rate as well as specific power improvements. This means superior performance, shorter compressor running time and less power consumed per cubic metre of compressed air produced.

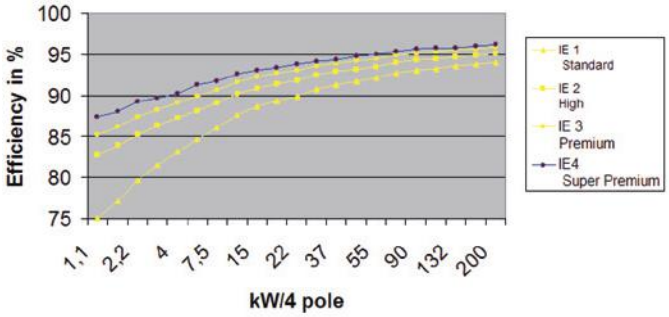

Image 5: Energy efficiency in drive technology

Conclusion

Answers to fundamental questions

When planning or renovating a compressed air system, the first step is to answer the fundamental questions: How high is the air demand? What pressure is required? What processes will the compressed air be used for and what are the compressed air quality requirements of these processes? Are there some processes in which the waste heat from the compressors can be reused?

To determine the answers, the system is closely examined in great detail, from all angles. First the pressures, flow rates and compressed air quality of the consumers are determined; next it's determined whether there is a decentralised treatment system. Finally the pipelines are considered in terms of their length, diameters and materials.

When it comes to centralised treatment, the required compressed air quality levels play a role, along with ambient conditions, including temperature, inlet pressure, inlet temperature and inlet moisture. The following parts of this series will examine all of these values in more detail, along with everything else required to successfully plan a modern compressed air station.

Following treatment, it's time to consider the compressors. What type of compressor is involved and if applicable, how is splitting implemented amongst the compressors? These are just a few of the important questions that have to be asked.

In order to ensure optimal efficiency of the compressed air supply, the system controller is absolutely critical. For larger stations, the ideal solution is a master control system that controls the entire station with maximum efficiency whilst also enabling modern energy management, data analysis and remote servicing, including predictive maintenance. In any case, the compressors themselves should be equipped with a controller that supports integration options.

When the entire system is taken into consideration, potential leaks also play a major role in the analysis. The following parts of this series examine these topics in detail and provide specific action recommendations to effectively achieve energy efficiency improvements.

To read more on this topic click here

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Our systems are designed to help healthcare facilities manage airborne viruses effectively by delivering clean, purified air where it's most needed. With a focus on safety and efficiency, INOVA ensures your facility is well-equipped for optimal air quality.

Each INOVA air purifier is fitted with H13 medical-grade HEPA filters to ensure the highest standard of filtration. We also offer the option to customise units with high-capacity activated carbon filters for enhanced chemical, odour, and toxin removal, providing an additional layer of protection.

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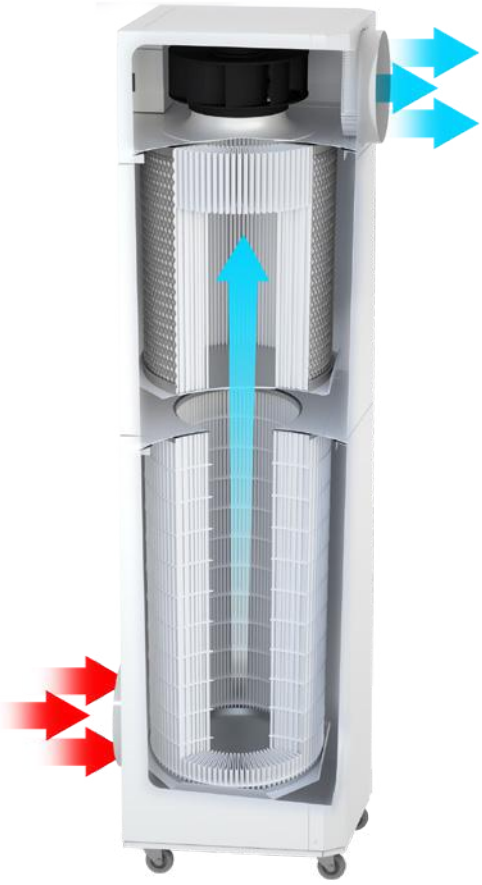

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FINAL RINSE WATER: ASSESSING DESIGN CHALLENGES

Dr Surani McCaw

Southland Filtration

This white paper examines the importance of final rinse cycles in washer-disinfectors (WDs) for reprocessing medical devices, emphasising the need to remove residual chemicals and contaminants to ensure safe device reuse. It discusses how the stages of final rinse cycles can vary based on WD type but the ultimate aim is to achieve device cleanliness. The paper highlights the significance of high-quality final rinse water in preventing recontamination of medical devices and ensuring patient and staff safety. Testing for residual chemicals, such as Glutaraldehyde (GDA) in endoscope reprocessing, is deemed essential and aligns with ISO standards. Design challenges including supply water quality, single-point design, detergent chemistry, and temperature control are evaluated, with a focus on implementing water treatment processes that are fit for purpose.

Introduction

It's interesting to note that despite being a standard practice in healthcare settings for over a decade, the term "Final rinse water" still lacks a comprehensive understanding of its application and significance. This highlights a potential gap in knowledge regarding its role in ensuring equipment performance, longevity, and ultimately, patient well-being.

Final rinse water is a critical component in the reprocessing of surgical instruments and endoscopes, serving to remove residual chemicals and contaminants after the cleaning and disinfection processes. However, its importance

By increasing awareness and understanding of the importance of final rinse water, healthcare practitioners can ensure that reprocessing procedures are carried out effectively, thereby minimising the risk of contamination and promoting better patient outcomes.

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may not be fully appreciated or understood by all stakeholders involved in healthcare settings.

To address this gap, further research and education are needed to elucidate the role of final rinse water in achieving optimal equipment performance and maintaining patient safety. This includes studying its impact on equipment longevity, its effectiveness in removing residual chemicals, and its contribution to overall patient well-being.

Understanding the role of final rinse cycles

In WDs employing thermal disinfection (as per ISO 15883-2:2018)[1], the final rinse water is typically used in the cycles directly following pre-rinse and hot wash cycles. This ensures that any residual chemicals from the pre-rinse and hot wash cycles are effectively rinsed off before the equipment undergoes thermal disinfection, using final rinse water between 80 and 90°C. This disinfection cycle serves as the last step before steam sterilisation, ensuring that the medical devices are thoroughly reprocessed and ready for safe use.

On the other hand, in WDs employing chemical disinfection (according to ISO 15883-4:2018)[2], the final rinse water is used in the cycles following pre-wash, wash, and disinfection cycles. This final rinse step is essential for removing any residual cleaning and disinfectant chemicals from the Endoscopes, ensuring that they meet safety standards before being used again.

While the stage of the final rinse cycle may vary, its primary purpose remains consistent: to rinse off residual chemicals and contaminants, thus ensuring the safety and effectiveness of the reprocessed medical devices. Understanding this process and its role in the overall reprocessing workflow is crucial for maintaining high standards of hygiene and patient safety in healthcare settings.

Here's why:

a) Suitable quality – The water used for the final rinse cycle must be of suitable chemical and microbial purity to avoid recontamination of the reprocessed medical devices. Any impurities in the water could compromise the cleanliness of the medical device, potentially leading to infections or other adverse outcomes for patients. Therefore, using water of high quality ensures that the reprocessed medical devices remain free from contaminants, contributing to improved patient safety and well-being.

b) Testing for residual chemicals – It's essential to test the final rinse water for residual cleaning and disinfectant chemicals. This step helps verify the effectiveness of the rinsing process in removing any leftover chemicals from the reprocessing cycle.

Martiny & Floss[3] evaluated both the residuals originated from patients as well as residuals originating from the reprocessing of endoscopes (i.e. both process chemicals and water contamination).

Their paper highlighted the importance of final rinsing in reducing residual levels of disinfectants like Glutaraldehyde (GDA) to safe thresholds. By testing for residual chemicals, healthcare facilities can ensure that reprocessed medical devices are safe for patient use and meet regulatory standards.

Ensuring the quality of the water used for the final rinse cycle is critical to achieve good patient outcomes.

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It emphasised the relevant sections within ISO 15883-1 which provide important guidance applicable to both WDs employing thermal disinfection (ISO 15883-2:2018) and WDs employing chemical disinfection (ISO 15883-4:2018). Here are some key points reiterated from ISO 15883-1:

SECTIONS 4.4.1

The-washer-disinfector shall be provided with a rinsing stage which reduces the concentration of process chemicals on the load to a level not exceeding that specified by the manufacturer, or supplier, of the process chemical(s) as safe in the context of their intended use of the product.

SECTIONS 4.4.2

Means shall be provided to ensure that the chemical and microbial quality of the final rinse water will not impair the standard of cleanliness and disinfection.

SECTIONS 6.10.6

The residual level which can be tolerated depend upon the nature of the chemical and the intended use of the product. The supplier of any chemical agent used should provide data on the composition of the chemical agent and the bio-compatibility of the components of the chemical agent.

Comparison of AS 5369:2023 requirements

In CSSD, where medical instruments undergo thermal disinfection and steam sterilisation, evidence of poor water quality affecting equipment performance and longevity have prompted the establishment of stringent water quality requirement as outlined in Table 7.2 of AS 5369:2023[4].

However, in case of endoscopy, where prevalence of procedures is lower in Australia, there is limited evidence available regarding the impact of poor water quality on Endoscope performance and longevity. This lack of evidence may stem from the relatively infrequent endoscopic procedures compared to other countries.

Table 7.3 of AS 5369:2023 focuses only on microbial parameters to safeguard patient health and states that chemical purity be according to manufacturer recommendations. By aligning chemical purity standards with the operational specification of the reprocessor, the standard aims to maintain the efficacy and the longevity of the reprocessing equipment and not the Endoscopes.

The observation that the level of residual disinfection chemicals in the final rinse water is not commonly checked to validate its safety for patients or healthcare workers, highlights a potential gap in quality control procedures within endoscope reprocessing.

It's crucial to recognise that while all WDs include final rinse cycles, the specific stage of these cycles can vary depending on the type of WD being used.

While Table 7.3 of AS 5369:2023[4] primarily focuses on microbial parameters for endoscope reprocessing, ensuring chemical purity is also essential for patient safety and equipment integrity.

Although it is observed that some suppliers introduce oxidising agents such as liquid chlorine or chlorine dioxide into the final rinse water to guarantee its compliance with Table 7.3 of AS 5369:2023[4], this practice is not recommended for reasons given in the sections below.

Furthermore, to my understanding, the level of residual disinfection chemicals in the final rinse water is not generally checked to validate the level that is safe for the patients or the healthcare workers.

As mentioned earlier, in most cases, oxidising chemicals are re-introduced into the final rinse water to guarantee its compliance with Table 7.3 of AS 5369:2023[4].

Design challenges

The challenges outlined in designing water treatment plants to supply Endoscope Reprocessors highlight several key considerations in ensuring the safety and effectiveness of the decontamination and the disinfection processes:

1. **Non-Potable Water Supply** – Although town water supplied to hospitals is typically coming from the drinking water supply network from a Water Corporation/Board is considered to be "potable", the supply to the endoscopy department is often labelled/classified as "non-potable".

   This distinction in is due to the regulatory requirement for the use of Reduced Pressure Zone Devices (RPZD) to prevent contaminants or pollutants from entering the drinking water supply network. Consequently, compliance with the Australian Drinking Water Guidelines[5] may not be guaranteed for water supplied to endoscopy departments, necessitating additional measures to ensure water quality.
2. **Single Point/Inlet Design** – Endoscope Reprocessors commonly incorporate a single point or inlet for water connection, making it challenging to separate the water supply for the final rinse cycle from other cycles such as pre-wash, wash, and disinfection. This limitation may affect the ability to control water quality specifically for the final rinse cycle.
3. **Chemistry of Detergents** – Detergents used in endoscope reprocessing are often designed for town

water supply quality, which may contain elevated chemical contaminant concentrations.

Using purified water with low soluble salts/conductivity may lead to foaming issues due to differences in water chemistry. Managing foaming is essential to ensure proper cleaning and disinfection of endoscopes.

4. **Temperature Control** – Maintaining water temperature within the optimal range (usually between 35 and 45°C) for enzymatic detergents is crucial for effective cleaning. However, many Endoscope Reprocessors lack heating elements or heat exchangers to maintain water temperature, necessitating precise control of the temperature of the water supplied to the Reprocessor. Additionally, controlling microorganisms, such as Pseudomonas Aeruginosa, at this temperature range without thermal disinfection poses challenges and requires careful monitoring and management to prevent potential risks.

Research indicates that the optimum growing temperature even for Legionella bacteria is 37ºC and they were found to remain in boilers for an average of 12 hours (0.5 days) at this temperature[6].

Addressing these challenges may involve implementing measures such as water quality monitoring, optimising detergent formulations, ensuring adequate temperature control, and implementing appropriate disinfection protocols to ensure the safety and effectiveness of Endoscope Reprocessing. Collaboration between healthcare facilities, water treatment experts, and equipment manufacturers is essential to develop comprehensive solutions that address these challenges while maintaining high standards of patient safety and infection control.

Key considerations for WDs under ISO 15883 Part 2

The considerations outlined for WDs employing thermal disinfection highlight the importance of both chemical and microbial quality of the final rinse water in ensuring the performance and longevity of the medical devices:

1. **Soluble Salts and Corrosion** – Elevated levels of chloride and sulfate in the final rinse water can lead to metal corrosion within the final rinse water deliver pipework and the WDs. This corrosion can be accelerated under elevated temperature conditions, leading to surface roughness that promotes biofilm growth. Biofilms, in turn, can exacerbate corrosion through Microbiologically Influenced Corrosion (MIC).

   To mitigate these risks, it's crucial for the final rinse water to meet both chemical and microbial parameters outlined in Table 7.2 of AS 5369:202344. Compliance with these parameters helps prevent corrosion and maintain the integrity of the medical devices being reprocessed.
2. **Bioburden and Endotoxins** – Thermal disinfection of water with high bioburden levels can lead to elevated endotoxin levels and the generation of thermotolerant bacteria. Endotoxins generated during the disinfection cycle can persist on medical devices post-sterilisation, as sterilisation does not remove endotoxins (i.e. sterilisation is not a depyrogenation process). This underscores the importance of controlling bioburden levels in the final rinse water to minimise the risk of endotoxin contamination on reprocessed medical devices.

Addressing these concerns requires comprehensive water quality management strategies, including regular monitoring and testing of both chemical and microbial parameters in the final rinse water. Additionally, implementing effective cleaning and disinfection protocols, as well as ensuring proper maintenance of WDs, can help mitigate the risks associated with corrosion, biofilm formation, and endotoxin contamination, thereby safeguarding the safety and performance of reprocessed medical devices.

Key considerations for WDs under ISO 15883 Part 4

In WDs employing chemical disinfection, such as per ISO 15883-4:20182, the final rinse cycle plays a critical role in removing residual disinfection chemicals before the Endoscopes are stored in drying cabinets prior to use. To ensure the safety and effectiveness of this process, it is recommended that the final rinse water meets specific criteria:

1. **Total Organic Carbon (TOC)** – Controlling the concentration of TOC in the final rinse water is crucial

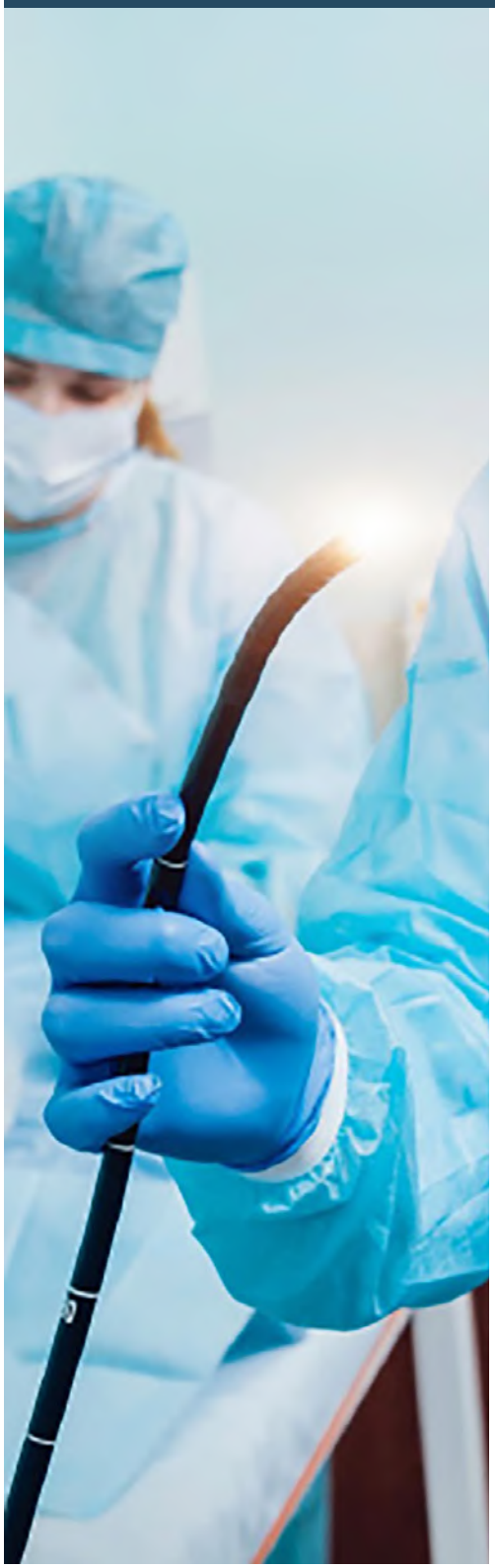
as elevated levels can indicate potential risks for biofilm formation.[7,8] TOC content below 1 mg/l is often considered a threshold for controlling bacteria count, highlighting the importance of maintaining low TOC levels to minimise biofilm formation and bacterial growth. Where TOC is not measured, Total Viable Count (TVC) must be monitored on a monthly basis.

2. **Soluble Salts** – Elevated levels of chloride and sulfate in town water supplies can lead to pitting corrosion when in contact with metals. Corrosion and surface erosion increase surface roughness, promoting biofilm growth and MIC as discussed earlier. To mitigate these risks, purified water with controlled soluble salts and conductivity of less than 40 µS/cm[9] is recommended to achieve better control of biofilm formation and hence corrosion.
3. **Bioburden** – High bioburden in the final rinse water can lead to re-contamination of reprocessed Endoscopes with bacteria.

   Controlling bioburden levels is essential to prevent bacterial contamination and ensure the safety of reprocessed Endoscopes.
4. **Oxidising Agents** – Avoiding the introduction of high-level disinfectants or oxidising agents such as chlorine dioxide, liquid chlorine, peracetic acid, hydrogen peroxide etc. to town water supply filtered via fine pore filters, without understanding the extent of bioburden in the water supply is crucial.

Some micro-organisms may survive exposure to these agents and develop resistance. Martin et al.[10] found certain bacteria strains that were isolated from Endoscope Reprocessors with high organic load can be more resistant to chlorine dioxide than hydrogen peroxide and peracetic acid. These studies emphasise the importance of selecting appropriate disinfection agents based on water quality and microbial characteristics.

This comprehensive approach helps mitigate potential risks associated with chemical disinfection processes and ensures the effectiveness of endoscope reprocessing protocols.



By adhering to these recommendations and ensuring that the final rinse water meets the specified criteria, healthcare facilities can effectively remove residual disinfection chemicals, minimise the risk of biofilm formation, and maintain the safety and integrity of reprocessed endoscopes.

The study by Pang et al.[11] underscores the challenges associated with ensuring water quality for final rinse cycles in endoscopy despite the common use of town water supply filtered via fine pore filters. The researchers found that despite filtration efforts, they were unable to achieve compliant levels of TVC due to biofilm formation in their water filtration plant, particularly in areas with dead legs.

To address this issue, Pang et al.[11] implemented several measures to minimise biofilm formation and improve water quality. These measures included minimising dead legs in the water filtration plant, incorporating automatic daily thermal flushing at 60°C for a minimum of 1 hour, and implementing a detailed program of filter maintenance. Despite these efforts, a sample collected from a duodenoscope still showed heavy growth of Pseudomonas Aeruginosa, indicating persistent challenges in ensuring water quality.

Another study[12] highlighted a facility in Italy that experienced endoscopy contamination

Overall, the findings emphasise the importance of ongoing vigilance and proactive measures to ensure water quality and prevent microbial contamination in endoscopy settings

with Pseudomonas Aeruginosa. In this case, the control mechanism involved frequent high-level disinfection with GDA followed by rinsing with Ethanol. This highlights the importance of implementing robust control measures to mitigate the risk of microbial contamination in endoscopy facilities. However, some of these control measures may not necessarily be suitable for the performance and the longevity of the Endoscopes but may also cause harm to patients.

Conclusion

Overall, the findings emphasise the importance of ongoing vigilance and proactive measures to ensure water quality and prevent microbial contamination in endoscopy settings. Addressing issues such as biofilm formation and implementing effective disinfection protocols are crucial steps in maintaining the safety and integrity of endoscopic procedures.

In one of our previous white papers, “Disinfection Sterilisation and Inactivation: Not knowing the difference could cost you a life”[13], we comprehensively evaluated the risks associated with various processes. This document elucidates the importance of understanding three fundamental terms in reprocessing medical devices. Through detailed analysis, it provides readers with a clear understanding of the distinctions between disinfection, sterilisation, and inactivation. By grasping these key terms, stakeholders in healthcare settings can make informed decisions crucial for patient safety and infection control protocols.

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Dr Surani McCaw is a Chemical Engineer with over 25 years industrial experience, specialising in water treatment in the Healthcare and Pharmaceutical Industries.

Surani holds a Bachelor of Engineering (Chemical) degree and a Doctor of Philosophy degree in water treatment from University of NSW, Kensington, NSW.

Dr McCaw has been involved in the implementation of National Healthcare Standards/Practices for both CSSD and Renal Dialysis since 2008 with the intention of evaluating and implementing risk managed and cost-effective water treatment technologies that are fit for the Australian ecological and demographical environment.

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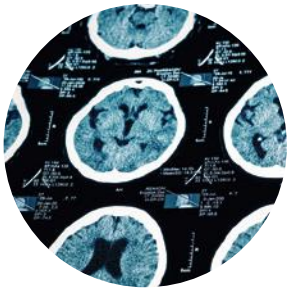

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REVOLUTIONISING ENERGY EFFICIENCY IN AUSTRALIAN HOSPITALS

THE FUTURE OF EC FAN TECHNOLOGY

Thomas Heine

ebm-papst

Hospitals in Australia operate 24/7, making energy efficiency a top priority. Many facilities still use traditional AC motor-driven fans, which consume large amounts of energy and increase operational costs. Retrofitting with high-efficiency Electronically Commutated (EC) fans provides an immediate solution, delivering energy savings, improved air quality, and a reduced carbon footprint. While some modern hospitals have adopted EC technology, the latest advancements push efficiency and reliability even further, making them ideal for critical healthcare environments.

Next-Generation EC Technology: Raising the Bar in Energy Efficiency

As hospitals look for more sustainable and adaptable solutions, the next generation of EC fans is revolutionising heating, ventilation, and air conditioning (HVAC) systems. These new technologies feature ultra-efficient motors with higher power density, intelligent control algorithms, integrated Active Power Factor Correction (Active PFC), and onboard sensors.

The Impact of Active PFC on Hospital Energy Efficiency

Active PFC is a game-changer for hospitals aiming to enhance energy efficiency. By correcting the phase difference between current and voltage, Active PFC improves the power factor, bringing it closer to 1.0. This ensures more efficient power consumption, reducing waste and lowering energy costs.

Another key advantage of integrated Active PFC is harmonic reduction. Hospitals rely on stable and clean power supplies to support critical medical and power equipment. Advanced EC fans with integrated Active PFC achieve <5% Total Harmonic Distortion (THDI) down to 10% of their power draw, even in disturbed power supplies. This eliminates the need for onsite adjustments during installation.

By reducing power distortions, Active PFC provides a stable, high-quality power supply, preventing overheating, reducing electrical noise, and improving overall system efficiency. Over time, this extends the lifespan of electrical equipment, lowers maintenance costs, and optimises hospital operational expenses—aligning with sustainability and cost-reduction goals.

Smart Ventilation Systems and Building Management System (BMS) Integration

Integrating these advanced EC fans with hospital Building Management Systems (BMS) enhances efficiency and simplifies maintenance. With improved connectivity, hospitals can centralise HVAC control, ensuring energy use aligns with real-time demand. Predictive analytics and automated adjustments further optimise energy consumption, reducing both carbon emissions and operational costs.

By adopting these cutting-edge ventilation technologies, healthcare facilities can create healthier, greener, and more cost-effective environments while ensuring uninterrupted, high-performance HVAC operation for critical hospital needs.

To summarise

Advanced EC fan technology with Active PFC significantly reduces energy waste, improves power quality, and lowers operational costs, making hospitals more energy-efficient.

Smart EC fan integration with hospital BMS enhances HVAC control, enabling predictive maintenance, reducing emissions, and ensuring long-term cost savings.

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Unlocking the Future of Healthcare: Revolutionary Compressed Medical Air System at Westmead Hospital

In a groundbreaking leap for Healthcare innovation, Westmead Hospital is now home to a state of the art Compressed Medical Air System and a newly built stand alone plant room, a turnkey project meticulously executed by Goldman Plumbing Services, redefining the standards of medical infrastructure.

Technological Advancements for Seamless Integration

With the project's design parameters set and overseen by Crowley Consulting, Goldman Plumbing's Engineering team has not only replaced but transformed the compressed medical air system at Westmead Hospital. The result is a cutting-edge system that flawlessly integrates functionality and efficiency, signalling a new era in Healthcare infrastructure. Importantly, this transition occurred seamlessly with the new system installed and commissioned without any disruption to the Hospital's Compressed Medical Air supply.

Reliability and Redundancy

The system boasts four Medical Compressed Air Compressors complete with advanced heat of compression dryers, featuring two water-cooled and two air-cooled compressors, ensuring 100% redundancy. This combination guarantees a continuous and dependable supply of medical compressed air.

Sustainable Healthcare Infrastructure

With a firm commitment to sustainability, the chosen Atlas Copco ZT37VSDFF generators incorporate variable speed drives, unlocking energy savings of up to 50%. Integrated heat recovery features contribute to eco-friendly operations by utilising up to 94% of compression heat for drying the desiccant filters, eliminating the need for additional energy sources.

Automated Efficiency Systems

The design incorporates a fully automated room ventilation and compressor cooling system. The systems control panel regulates fan usage based on operational room temperatures, optimising energy consumption for maximum efficiency and cost-effectiveness.

Advanced Monitoring and Alert Systems

A dedicated Medical Air Alarm System receives digital signals from compressors and pressure sensors, promptly alerting system operators to any critical alarms or warnings. Real-time insights into operational parameters are provided through Building Management System connectivity with high level interface.

Resilient Design for Unmatched Reliability

The Medical Compressed Air Plant and Mechanical Services control centre comprises four individual modules, showcasing a commitment to reliability. Each module is dedicated to supplying specific plant and equipment, allowing the system to fully operate during maintenance periods or partial system failure.

Holistic Approach to Project Success

Goldman Plumbing's holistic approach extends beyond the medical compressed air systems design and installation. Goldman Plumbing also designed and constructed the dedicated stand alone plant room. Not only does this approach provide a single point of accountability for the entire project, it also ensures seamless translation of the systems design intent into fully functional and reliable Healthcare infrastructure.

Excellence in Compliance

The Compressed Medical Air System not only meets but surpasses all relevant Australian Standards and modern Healthcare facility expectations. This project signifies a stride towards excellence in medical facilities, where innovation meets reliability and the future of healthcare infrastructure is now a reality.

Level Up Your Hospital Operations

Crafting an Autonomous Machine Strategy with FloorBotics Leading the Charge

For Hospital Engineers: Optimising Efficiency and Patient Care in the Age of Autonomy

Healthcare landscape is constantly evolving with technology – as hospital engineers, you are at the forefront of implementing solutions that enhance operational efficiency, improve patient care, and create a safer environment.

But it isn't simply about deploying robots – it needs a strategic plan to maximise the potential.

Identify operational gaps and safety concerns – analyse your current operational workflows. Where are the bottlenecks? Consider areas where automation can significantly impact efficiency, safety, or patient experience.

Define clear objectives and KPIs – what specific outcomes do you want to achieve with autonomous machines? Examples include reducing cleaning time, or improving infection control.

Assess technology options and suitability – assess available technologies and evaluate factors like navigation systems, sensor technology, battery life, safety features, and ease of use.

Evaluate your infrastructure – are there any necessary adjustments? Implement a phased rollout, beginning with pilot projects and providing staff training. Prioritise data security and address ethical implications, such as workforce impact.

Floorbotics offers a prime example. The FloorBots allow thorough automated cleaning with advanced and secure data collection on cleaning patterns, allowing you to optimise cleaning schedules and resource allocation. They can also perform complex navigation capabilities with advanced safety features to navigate the hospital environment seamlessly, while ensuring the safety of patients and staff around it.

A robust autonomous machine strategy, incorporating solutions like Floorbotics, is vital for optimising hospital operations and fostering a safer, patient-centered environment. Hospital engineers play a crucial role in this transformation, and a well-defined strategy serves as a roadmap for success in the era of autonomy.

CREATE FOSSIL FREE ENERGY PRODUCTION FOR HOSPITALS

Florent Donnard and Jean-Marie Melo

Climate engineers Florent Donnard and Jean-Marie Melo discuss why, in order to create opportunities for energy and waste heat recovery in hospitals, the creation of energy profiles for such facilities is so important.

Since the Meadows report *The Limits to Growth* published in 1972 and the 1992 Rio de Janeiro United Nations Conference on Environment and Development, the world has gradually realised its considerable impact on the environment. As different IPCC reports have been released, the link between carbon emissions and other greenhouse gases, the scarcity of energy resources, and environmental damage has become clear. Alongside these environmental crises, the world has also experienced geopolitical and economic disruption. The combined effect of these events creates an array of constraints, leading public authorities to implement actions for a low carbon footprint and low energy consumption.

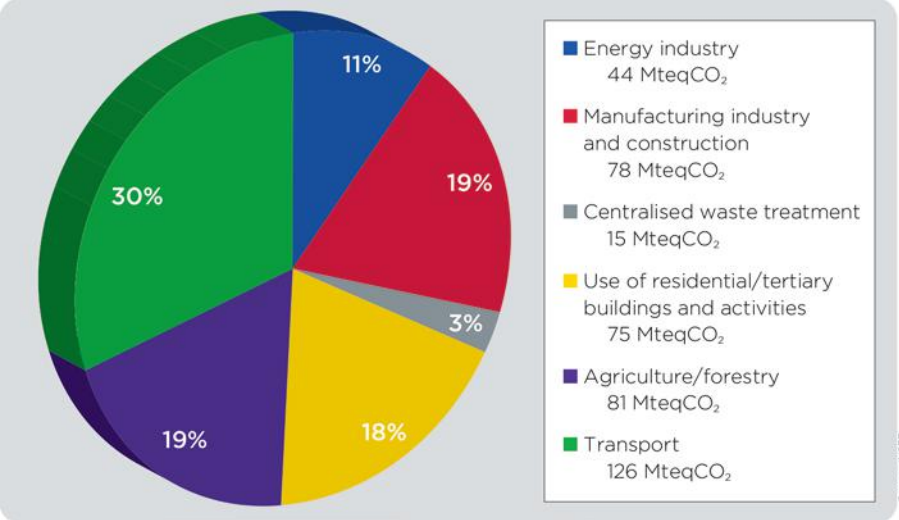

Figure 1. GHG emissions in France in 2021 by business sector.

In France, greenhouse gas (GHG) emissions per business sector are distributed as shown in Figure 1.

Healthcare, included within the industry and construction and residential and tertiary activities sectors, accounts for eight per cent of French GHG emissions, according to the Shift Project studies. Considering the essential position of the healthcare sector in the French social model, we think that our French and European healthcare facilities should set a positive example in terms of controlling and reducing their carbon footprint.

How can a hospital work towards 'zerocarbon'? After explaining the creation of energy profiles for these facilities to define their needs, we will present opportunities for energy and waste heat recovery. By highlighting the different carbon footprints of energy sources in France and some principles of energy production, we will be able to offer an example of a technical architecture for energy production that meets the objectives of controlling GHG emissions and the needs of an acute care healthcare facility. About the approach

To decarbonise a healthcare facility, we need to understand it in three stages:

- *Controlling its consumption and therefore the energy needs of its buildings:* a fully decarbonised kWh is a kWh that is not used. The recent steep rise in energy prices and their current volatility reinforces this reduction and control approach. This approach was also supported in France by the deployment of the RT 2005 and then RT 2012 regulations.
- Next, *controlling the energy source to meet its needs:* depending on the region's offer, the choice shifts to energies that meet needs (e.g. a distribution temperature regime) and carbon neutral targets. The arrival of RE 2020 tends to favour the emergence of zero-carbon sources of energy production.
- This ultimately results in the *selection of energy production architecture* (biomass boiler, solar panels, etc.) that meets needs while also offering a zero-carbon source of energy.

Final energy consumption profiles

Needs

Reducing the carbon footprint of a healthcare facility in terms of needs is tackled on two sides:

- *The static part*, the envelope's performance, which includes losses through walls, ingress, or solar gains.

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- *The dynamic part*, usage, i.e. consumption linked to fresh air and air quality, domestic hot water and processes.

Regarding static needs, over the last twenty years, we can see that successive thermal regulations have led to a stark improvement in building envelope performance, in terms of insulation, joinery, thermal bridges, and airtightness. This technical approach, combined with a bioclimatic approach, helps manage the building's envelope (Fig 2).

The implementation of energy recovery systems in ventilation systems has also significantly reduced heating needs linked to fresh air. However, while greater use of air conditioning has been offset by greater use of sun protection, climate outlooks point to a considerable rise in cooling needs, whose impact can be appreciated with the 'extreme' weather files that include IPCC forecasts.

The dynamic energy needs of a hospital building are complex to understand, as they largely depend on hosted services whose consumption profiles differ completely: according to the energy readings of a Brittany hospital delivered in the 2010s, heating and cooling consumption per m2 of a surgical department are 8-10 times higher than the inpatient wards. However, those linked to DHW (domestic hot water) are 8-10 times lower (Fig 3).

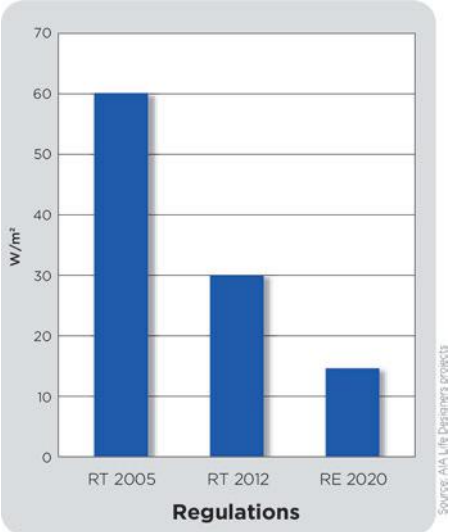
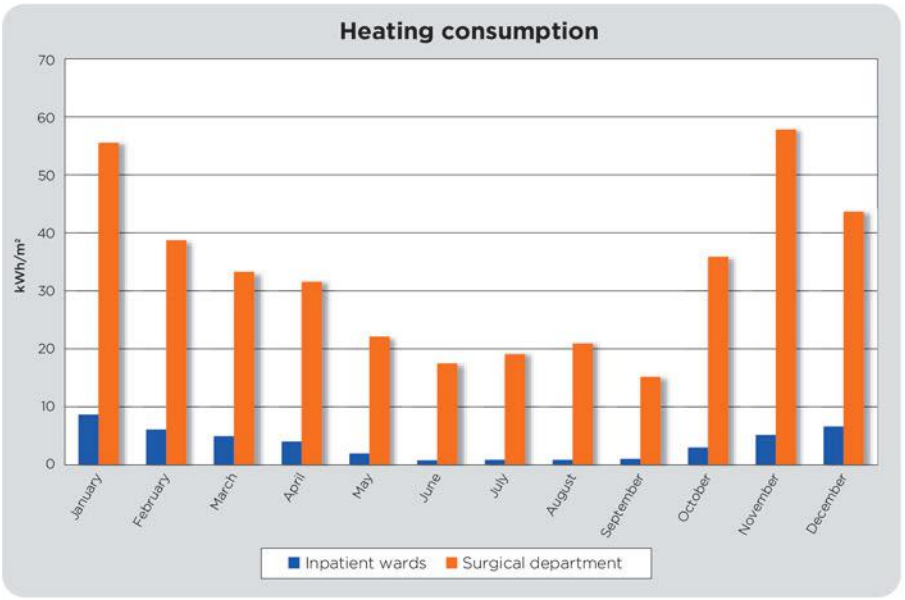
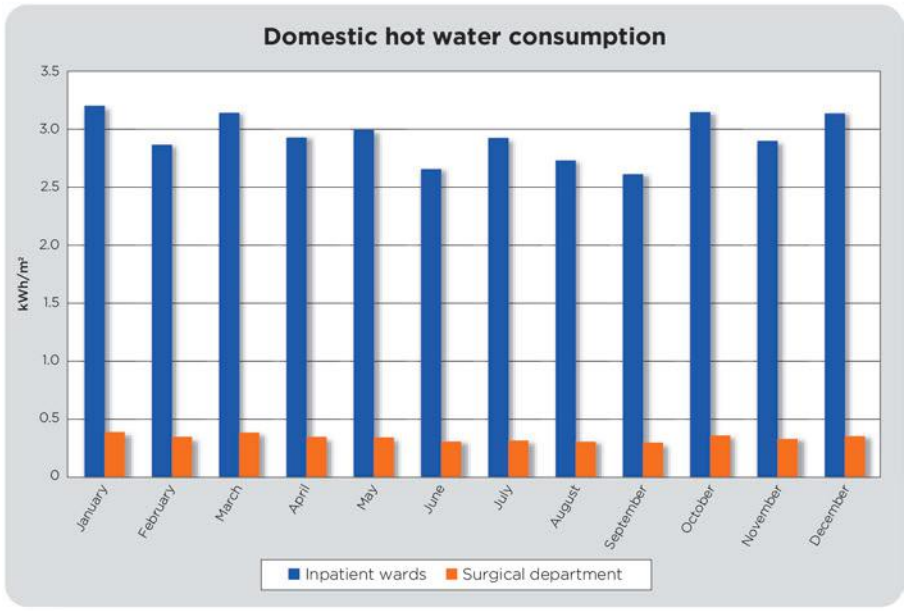


Figure 2. Envelope performance: static heating needs per m2 for a tertiary building.





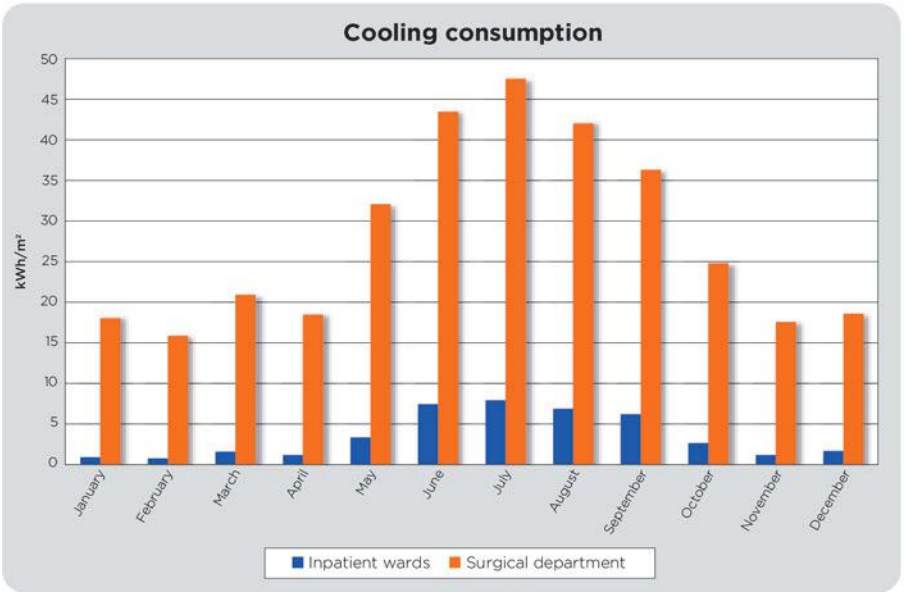


Figure 3. Energy consumption profiles – feedback from delivered project.

Table 1. Carbon footprint of main primary energies [Source: 'Energy – Carbon' reference for new buildings].

	Natural gas	Fuel oil	Propane	Wood pellets	Logs	Plaquettes	Photovoltaic	Wind	Solar	French nuclear
$kgCO_2eq/kWh$	0.243	0.314	0.27	0.027	0.032	0.013	0	0	0	0

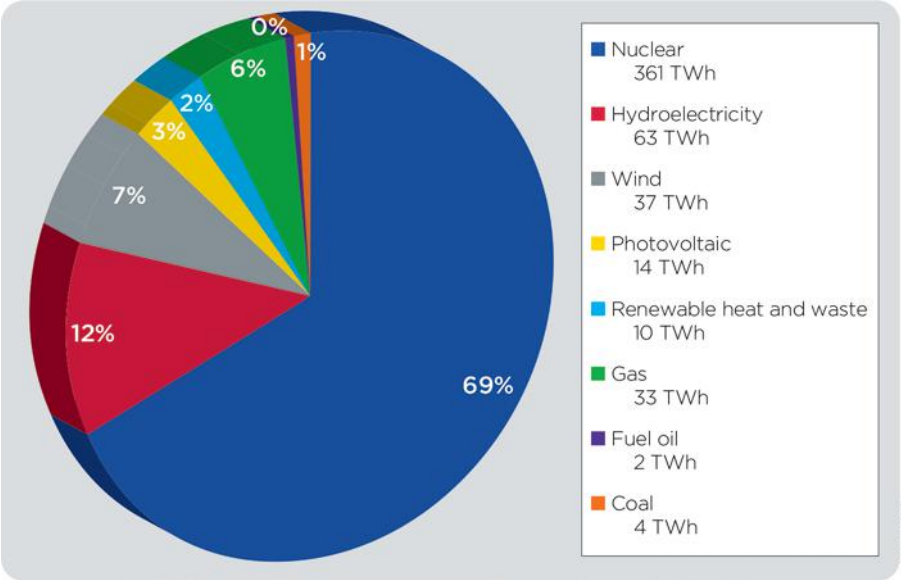


Figure 4. Electrical kWh produced in France.

A simple approach based on the proportion of the built surface area – not taking into account the consumption differences between departments – would not be appropriate at all to correctly estimate the energy consumption profiles of a future hospital building. So we need to have monthly energy readings for actual buildings, broken down by major entity and associated with characteristic quantities that can be used as distribution criteria: for example, the energy consumption of an intensive care unit according to the number of beds, a surgical department according to the number of operating rooms, or an imaging department according to the number of MRIs/Scanners. It is also essential to identify the main technical or programme decisions with an influence on consumption (air conditioning for accommodation and consulting rooms, ventilation type, specific equipment).

By combining this data with outdoor weather conditions and building performance, reliable consumption profiles can be created for future hospital buildings.

Recovery of waste and renewable energies

Alongside developing need profiles, it is crucial to determine the potential combination of heating and cooling needs to recover waste energy. Indeed, in a hospital building, there are various pieces of equipment and departments requiring cooling all year round, including electrical and IT rooms, MRIs, sterilisation autoclaves, kitchens, mortuary cabinets, and so on. Rather than releasing this available energy into the environment, it is preferable to recover it to pre-heat domestic hot water or a low-temperature heating circuit.

An analysis of the region's renewable energy potential is also carried out and compared against needs to determine potential correlations between renewable energy sources and usage profiles: thermal solar energy covering some summer DHW needs or a short supply chain of wood chips.

Carbon assessment of energy sources

With building energy needs known and controlled, the focus shifts to optimising the choice of energy supply and associated production.

The carbon footprint of a billed energy supply (final energy) includes all supply chain energies to obtain primary energy, so an Urban Heating Network (UHN), whether supplied by a coal-fired station or geothermal energy, will not have the same carbon footprint.

Currently, the carbon footprints of primary energies in France are as in Table 1.

These primary energies can be available at the point of consumption, and thus can also be final energies. However, the carbon footprint of electricity and heating or cooling networks depends on the 'energy mix' used to produce them.

To be produced, electricity needs one or several sources of primary energy, which is transformed and transported to points of consumption. Thus, a gas-fired thermal power plant transforms primary energy into thermodynamic energy through water evaporation and steam pressurisation, then into mechanical energy by moving a rotor to obtain electricity by creating an electromagnetic field.

In France, the electrical mix – i.e. the distribution of different sources of primary energy to produce electricity – is significantly dominated by nuclear and renewable energy. As its composition is mainly from nuclear and renewable energies, French electricity has a low carbon footprint (Fig 4).

It should be noted that, at a given time – 't' – the energy mix of electricity varies. In winter, to cover additional heating demand, RTE needs to fire up gas-fired thermal power plants, mechanically increasing the carbon footprint of a consumed kWh. In France, the average carbon footprint of an electrical kWh depends on usage (Table 2).

With regards to UHNs, each network has its own energy mix, and therefore the carbon footprint of the kWh is unique to each facility. These values are regulated and published in the

annexes of the decree of 15 September 2006 on the energy performance diagnosis (Table 3).

Once the consumption profiles are known, sources of renewable and waste energy identified, and the region's energy supply mapped, it is possible, based on a range of energy production types, to build technical architecture unique to the project.

Technical architecture of energy production

Before offering an example of technical architecture, we will explain some production principles adapted to use for healthcare buildings.

Production principles

- *Production of solar DHW:* Within renewable energies, solar can be used in healthcare facilities in various ways.

Given the regular and relatively significant needs for domestic hot water, linked to accommodation departments (around 50 litres of domestic hot water per day, per bed), thermal solar energy is particularly well suited to any type of healthcare facility (nursing home, followup and rehabilitation, hospital, etc.). Solar energy can be used directly through a transfer via heat exchangers or combined with intermediate heat pumps allowing a back-up source to be avoided (or at least to limit its use). In particular for direct transfer, the size of the installation must be calculated with low consumption assumptions to avoid any overheating likely to cause damage to the solar panels.

Photovoltaic solar energy is a simple, relatively cheap solution that is separate from the facility's operations, which can be consumed on site or resold, and whose installation can potentially be entrusted to a third-party investor.

Finally, so-called hybrid solar panels combining photovoltaic and thermal energy are quite an appealing technical solution. The heat released by the photovoltaic cells is absorbed by a water loop, limiting their rise in temperature, and thus extending their life span and ensuring stable performance over time. The recovered heat is used in the same way as in a conventional solar thermal system.

- *Heat pump and recovery refrigeration unit:* To properly appreciate the recovery potential of a healthcare facility, we must understand how a heat pump works.

A heat pump (or HP) is a thermodynamic machine working on the principle of energy exchanges when a fluid changes states. In addition to the energy required to raise the temperature, it takes additional energy to change from one state to another; from liquid to gas. For liquid water, a quantity of energy is provided to raise the water's temperature to 100°C; sensitive heat. Then once at 100°C, another quantity of energy is injected to transform liquid water into gas; latent heat.

Using an electrical source, an HP alternates between rest (liquid to steam, capturing energy) and compression (gas to liquid, returning energy) phases to transfer energy from one place to another. So in refrigeration unit (RU) mode, an HP

Table 2. Carbon footprint of electricity depending on usage

	Electric heating	Air-conditioning	Domestic hot water	Lighting
kgCO2eq/kWh	0.21	0.066	0.066	0.066

Table 3. Morbihan network performance as per decree of 15 September 2006.

	Network	Company		kWh
56	Réseau de Lanester	Lanester	C	0.058
56	Réseau de chaleur Zac Centre	Hennebont	C	0.000
56	Réseau de Gumenen	Aurey	C	0.176
56	Réseau de chaleur Liger	Locminé	C	0.000
56	Réseau de la Commune de Guer	Guer	C	0.058
56	Réseau de Serent	Serent	C	0.058

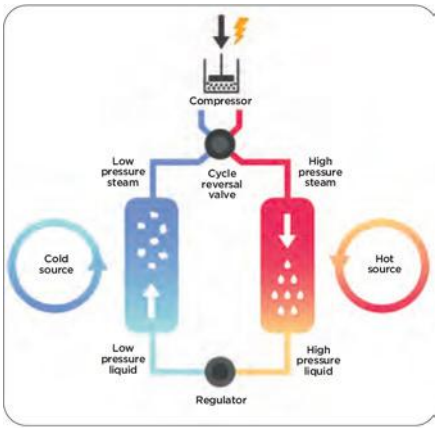


Figure 5. How a heat pump works.

absorbs energy from a cold source to cool, to return it to a hot source. This waste energy is either recovered or lost. The HP works by exchanging with water (groundwater, a distribution network), the ground (geothermal probe), or air (released waste heat) (Fig 5).

From an energy point of view, a heat pump at full load produces around 3 kWh of refrigerating energy (EER) and 4 kWh of thermal energy (COP) from 1 kWh of electricity.

Suggested zero-carbon technical architecture for a hospital site

The example of technical architecture proposed below corresponds to an architecture designed for a hospital in the Paris region with a surface area of approximately 20,000 m2, with a surgical department with around ten rooms, a critical care unit, and over two hundred inpatient beds.

In recent years, controlling the building's envelope has helped drastically reduce heating and power needs of emitters and encouraged the creation of low-temperature heating solutions which until then were unsuitable, like heat pumps. Indeed, while heat pump-type thermodynamic

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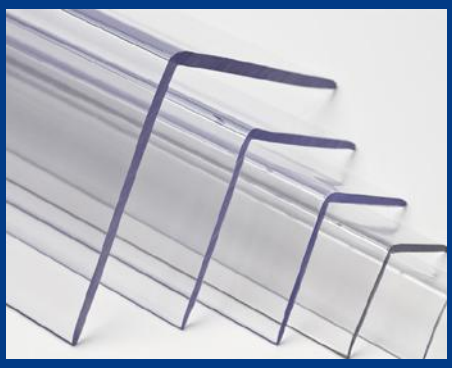

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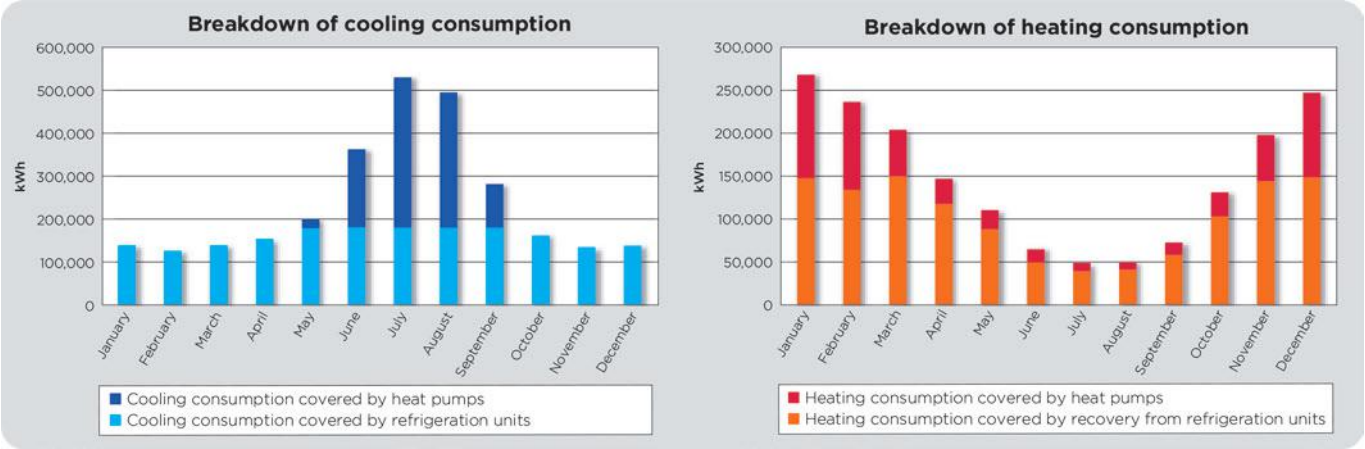

Figure 6. Estimated distribution of coverage of heating and cooling needs of a hospital building between HP and energy recovery RU – considering 80 per cent recoverable recovered energy.

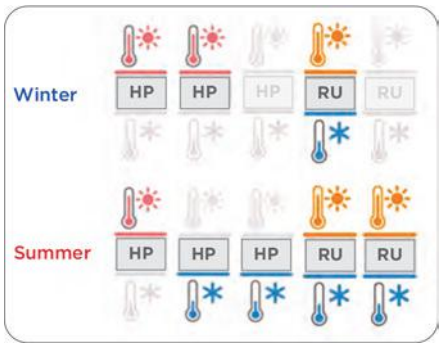

Figure 7. Winter/summer distribution of energy production equipment.

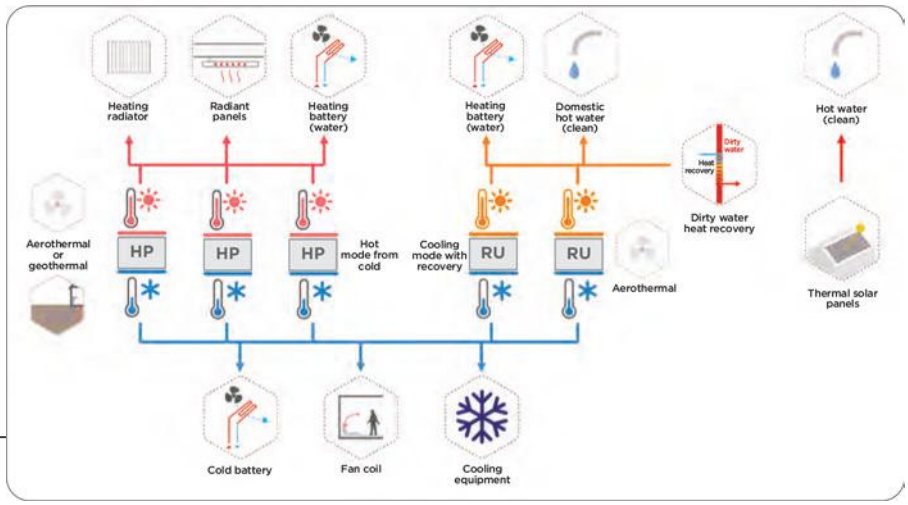

Figure 8. Simplified diagram type associating reversible heat pumps and recovery refrigeration units.

machines offer outstanding performance at low temperatures (up to 45°C/50°C), their performance collapses at high water temperatures.

As a result, it becomes worthwhile to separate heating production from domestic hot water production, as it requires a minimum temperature of 60°C.

After identifying combined heating and cooling needs in order to optimise the installation's performance, it is preferable to install refrigeration units with water condensers to recover available thermal energy, rather than release it into the environment. The use of storage tanks can absorb slight differences in phase and maximise the use of this recovered energy. This combination is analysed on a seasonal level but also day to day to balance needs between day and night (Fig 6).

The association of these energy recovery refrigeration units with reversible heat pumps (operating in heating mode in winter and air conditioning mode in summer) helps limit or even reduce investment, thanks to the partial pooling of hot and chilled water production, while securing the energy supply.

Heat pumps supplying heating in winter will switch to air conditioning mode in summer. A single pump will be kept in heating mode, notably to cover reheating needs after dehumidification. If a heat pump or unit fails in summer, all heat pumps will switch to air conditioning mode, and the energy recovered from refrigeration units will cover residual heating needs (Fig 7).

This partial redundancy of equipment associated with the site's secure electricity supply (power generators, Enedis supplies, high voltage loops) ensures a continuous heating and cooling supply.

In this production diagram, geothermal solutions – until now rarely used due to their investment cost – become financially relevant due to the energy savings created by optimising the performance of heat pumps and subsidies that can be received via the Fonds Chaleur. A good understanding of the heating capacity of the subsoil allows drilling to be calculated in accordance with thermal characteristics and sustainability: For geothermal probes, the annual review between recovered and returned energy must be balanced to ensure resource sustainability. Production is supplemented by air condensation refrigeration units for peak needs in summer (Fig 8).

As indicated previously, there must be a special focus on domestic hot water production. Other than pre-heating

through refrigeration unit energy recovery (insufficient to reach a temperature of 60°C), production can be covered by high-temperature heat pumps. However, as high-temperature heat pump performance is mediocre at low outdoor temperatures, it is preferable not to use outdoor air directly as a cooling source, but to use an intermediate mid-temperature network to improve performance and achieve satisfactory results.

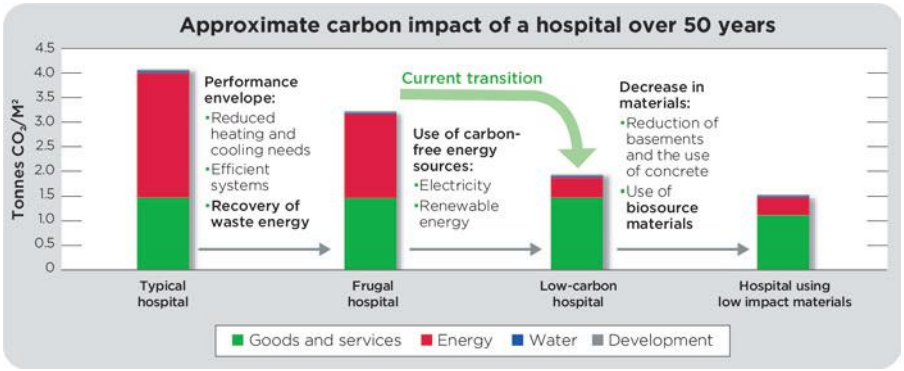

Figure 9. Changes to a hospital's carbon footprint over time.

With this aim, DHW production by heat pumps is paired with hybrid solar panels combining photovoltaic and thermal energy, a technically appealing solution. The heat released by the photovoltaic cells is absorbed by a water loop limiting their rise in temperature, and thus extending their life span and ensuring stable performance over time, while the electricity produced supplies the High- Temperature HP supply and distribution pumps. The recovered heat is used in the same way as in a conventional solar thermal system.

Conclusion

Following an initial stage to improve the envelope and implement effective waste energy recovery systems that has reduced the energy consumption of the hospital buildings, a new phase is underway to transition to zero-carbon energy sources. This will help to drastically reduce the carbon emissions linked to the energy consumption of the healthcare facilities. This means that their initially significant carbon footprint will become insignificant compared to the carbon footprint from construction. Efforts will then be focused on savings in terms of construction materials and, notably, the use of biosourced materials. Combined with limited land development, the ambition to reduce carbon emissions will also result in a significant increase in energy and functional renovation operations at existing buildings and sites in the future (Fig 9).

About the Authors

Florent Donnard

After his debut as a professional installer, Florent Donnard, a graduate engineer from ESSTIN (now Polytech Nancy), joined the HVAC engineering department of the AIA group's Nantes branch in 2007. While working on a wide range of building types (offices, teaching, technical centre), he has come to specialise in private hospital projects (several clinics for the ELSAN group – Nantes, Narbonne, Angoulême – extensions to the Clinique Jules Verne in Nantes, several SSRs for the LNA santé group) and public projects (partial restructuring of a high-rise building at the Pontchaillou University Hospital in Rennes, Hôpital Femme Mère Enfant at the CHR in Metz, reconstruction of the Caen University Hospital). In addition to his role as an HVAC specialist, he is now also the AIA Group's 'healthcare design' contact for HVAC design issues.

Jean-Marie Melo

After graduating from ESEM (now Polytech'Orléans) with a degree in fluid mechanics, Jean-Marie Melo began his career in energy management and the building industry by drawing up an Environmental Enterprise Plan for all the fire stations in the Deux-Sèvres département (79). Following this experience and being convinced that building is a major lever for energy management, Jean-Marie continued his studies to obtain a DU in Renewable Energy and Building at the University of Chambéry. Since 2013, Jean-Marie has been working at AIA's Paris office, developing hospital projects such as the Institut Curie in Saint Cloud and the CHU in Caen. Today, he oversees the HVAC and plumbing design department of the Paris agency and is involved in renovating the HVAC technical services of the Centre Pompidou

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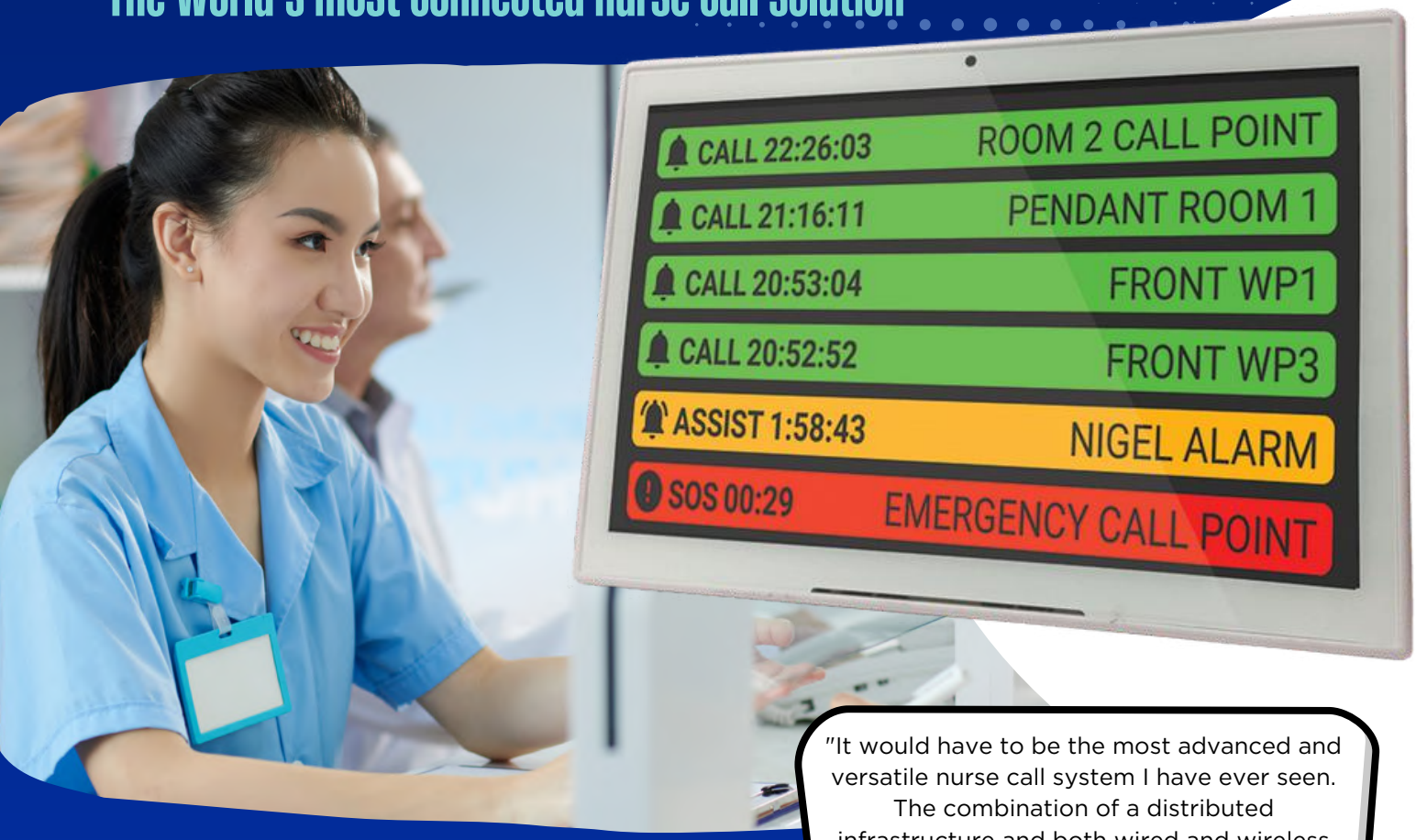

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ABOUT MACDONALD CONSULTANCY

Macdonald Consultancy was established in 2017 as a specialist facilities management and asset management consultancy, to fill a gap in the market. To bring robust, research-based consultancy support to the facilities management and asset management sectors. Key facets of our service delivery model include:

- A multi- disciplinary team of directly employed consultants.
- Subject matter expertise.
- Thought leadership; and,
- An innovation partnership with RMIT.

Our services include:

Asset audits and condition surveys – clients typically require this service for a number of reasons including asset register compilation, for the population of asset management systems, to benchmark asset condition, to support maintenance planning and to assist with ISO 55000 and other similar compliance obligations.

Facilities Management Strategic Reviews – working with clients we review the status of facilities management, provide a gap analysis with the recommended position and provide an options appraisal and an implementation plan to close the gap enabling the client to achieve quality improvements and cost optimisation.

Asset Management Maturity – we measure and report the organisations asset management performance against a range of criteria including leadership and accountability, planning, acquisition, operation, and disposal and provide a road map to address any shortcomings identified.

Estimating – Macdonald Consultancy undertake estimates for a broad range of asset management and facilities management activities including planned maintenance, reactive maintenance and life cycle works. There are a wide range of reasons why clients may wish to know the cost of these activities for example they may want to understand the whole of life costs of a new building development or to check that the amount that they are paying is in line with the market.

Lifecycle modelling- using the CAMS tool we forecast the deterioration of assets, over time with due consideration of location and environment and estimate the cost of replacing those assets enabling clients to make informed decisions around the asset base from a whole of life cost point of view.

About the CAMS Partnership

The CAMS partnership between Macdonald Consultancy and RMIT began in 2015 when Donald Macdonald first encountered the CAMS asset life cycle modelling software and met the CAMS development team. Donald immediately recognised the game changing nature of this innovative software and its many unique features and was particularly struck by the following:

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- The CAMS architecture enables data to be hosted in the format that best meets client need and is fully compatible with the full range of commonly occurring asset structures.
- CAMS is highly flexible enabling reports to be generated in the format and with the content most appropriate to user needs.
- CAMS offers the user the ability to model various scenarios to enable the matching of asset replacement activities with limited budgets.
- CAMS offers the user the ability to categorise asset replacement requirements from a range of viewpoints e.g., risk, criticality, etc.
- CAMS can present asset data in a way that can be readily understood by technical and non- technical people alike.
- CAMS helps to translate technical data into financial information.
- CAMS can help support business cases for asset replacement by illustrating the linkage between core business and assets identified for replacement.
- CAMS enables effective succession planning through features that include multi- layered password protection, a rigid data base structure and the hosting of data in the cloud.
- CAMS helps with managing the executives expectations through the identification of expensive high- risk asset replacement requirements several years in advance.

Being a research organisation RMIT are focussed on developing CAMS to provide ongoing value to clients and are continually updating the tool to meet clients' evolving needs, current research initiatives include enhancing the functionality of the system, measuring and reporting the carbon footprint of the clients asset base and supporting the circular economy.

CAMS is currently deployed on over 5,000,000m^2 of property throughout Australia and with the release of the CAMS 2 asset management software system the asset management partnership between Macdonald Consultancy and RMIT goes from strength to strength.

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MONITORING WATER QUALITY IN HEALTHCARE SYSTEMS

Muhammad Atif Nisar, Kirstin Ross, Melissa Brown, Richard Bentham, Giles Best, James Xi, Jason Hinds, and Harriet Whiley

Muhammad Atif Nisar, Kirstin Ross, Melissa Brown, Richard Bentham, Giles Best, James Xi, Jason Hinds, and Harriet Whiley investigate the water stagnation/flow and temperature profiles at thermostatic mixing values (TMVs) and hand basin outlets on VBNC and culturable *Legionella*.

Hospital and healthcare building water systems have been identified as a major source of Legionnaires disease – a potentially fatal pneumonia-like infection caused by the *Legionella* bacteria. *Legionella* is ubiquitous in natural and engineered water systems and is transmitted through aspiration or inhalation of *Legionella*-contaminated water or aerosols. Those at greatest risk of infection are the elderly and immunocompromised individuals, and, as such, healthcare outbreaks associated with hospital engineered water systems are of significant concern.[1]

Globally, the incidence of Legionnaires disease has been increasing.[2–4] As such, there is a need for improved monitoring and management strategies to control *Legionella* within hospitals and healthcare facilities. One of the biggest challenges for *Legionella* management within these systems is that, under unfavourable conditions (e.g. disinfectants, low nutrients and heat stress), *Legionella* transforms itself into a viable but non culturable (VBNC) state that cannot be detected using the standard methods. Concerningly, VBNC *Legionella* are still alive and infectious and can transform back into a culturable form under favourable conditions.[1]

A range of factors influence the survival and persistence of *Legionella* in hospital water systems. This includes biofilms, nutrients, protozoan hosts, water temperature, flow dynamics, and stagnation.[5–7] Previous research has shown that permanent stagnation points in engineered water systems, such as dead ends and dead legs, are known to increase biofilm formation and the risk of Legionnaires disease. However, less is known about the effect of stagnation occurring at end of the line through intermitted usage of outlets. The aim of this research was to utilise an Enware SMART FLOW monitoring system to investigate the water stagnation/flow and temperature profiles at thermostatic mixing values (TMVs) and hand basin outlets on VBNC and culturable *Legionella*. The relationships between these water parameters and *Legionella*, heterotrophic plate count (HPC) bacteria, and free-living amoeba were also explored.

Methods

Shower and hand basin water and biofilm (slime) samples were collected from the patient en suites within an NSW hospital. A total of 120 water and 46 biofilm samples were collected during four sampling phases from March 2021 to June 2022. The samples were analysis for *Legionella* using the standard culture based detection method (AS 5132:2017); however, they were also analysed using qPCR (ISO/TS 12869:2019), which detected *Legionella* DNA (this includes both alive and dead cells) and our novel method (flow cytometry-cell sorting and qPCR [VFC+qPCR] assay)[8] which detected and enumerated the VBNC *Legionella* that cannot be detected using the standard culture method. The samples were also analysed for HPC and total amoebae using culture. In addition, the common *Legionella* host amoeba, *Vermamoeba vermiformis* and *Acanthamoeba*, were enumerated using qPCR.

Parameters related to water temperature and flow dynamics were monitored in the hospital water system using

Figure 1. Enware Smart® Flow System for a patient ensuite with thermostatic mixing valve (TMV) and basin monitoring devices.

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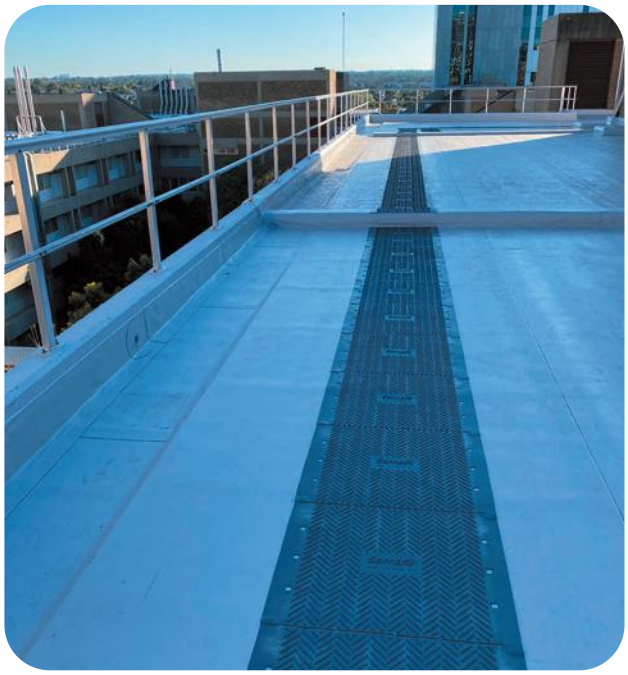

Westmead Hospital is a large public hospital in Sydney, Australia, providing high-quality healthcare services to the local community. In 2020, the hospital embarked on a major roofing project to waterproof over 25,000m^2 of its roof in a PVC membrane. The project was awarded to Danrae Group, a leading waterproofing contractor in Australia, with a reputation for delivering high-quality work on complex projects.

The project posed several challenges for Danrae Group, including managing the project on a live site, working with stakeholders, and managing noise works and logistics. The hospital remained operational throughout the project, which meant that the project team had to work around the clock to minimise disruption to patients, staff, and visitors.

One of the significant challenges faced by Danrae Group was dealing with the existing membrane, which had traces of asbestos. The team had to encapsulate the existing membrane with a new PVC membrane to ensure the safety of everyone on the site. The team placed a high focus on safety and adhered to strict safety protocols to ensure the safety of the workers and the public.

The installation of the PVC membrane was completed in two stages. The first stage involved the installation of the glue fix layer, which acted as a temporary layer to prevent water ingress while the finished PVC layer was being installed. The second stage involved the installation of the finished PVC layer, which was welded onto the glue fix layer to create a seamless and waterproof surface.

Another significant challenge faced by Danrae Group was managing the logistics of the project. The team had to coordinate the delivery of materials, equipment, and personnel to the site while minimising disruption to the hospital's operations. The team worked closely with the hospital's management team to schedule works at the least disruptive times and to communicate any potential disruptions in advance.

Despite the challenges faced by Danrae Group, the project was completed on time and within budget. The waterproofing of the hospital's roof in a PVC membrane has significantly improved the hospital's infrastructure, providing a long-lasting and durable solution that will protect the hospital from water damage for many years to come. The project has also demonstrated Danrae Group's expertise in delivering complex projects on live sites while adhering to strict safety and quality standards.

the monitoring system (Fig 1). Briefly, the system measures water system delivery temperatures using temperature probes located at the hot water inlet, cold water inlet, and outlet of the thermostatic mixing valves (TMV) and the hot water inlet and cold water inlet of hand basin faucets. Water flow was measured using flow switches located at the hot water inlet and cold water inlet of both the TMVs and hand basin faucets. The temperature data of the hot water supply, cold water supply, and outlet was collected for the entire duration of the sampling period. For analysis, these measurements were separated and then averaged over a period of one week and one month prior to a water sampling event. In terms of flow regime, the total duration (hours) and number (counts) of flushing events for a period of one week and one month prior to sampling were recorded. The total duration (hours) of flushing events were divided into low and high flow regimes with categorisation as: low flow regime; 0 to <2 hours per month, and high flow regime; ≥2 to 40 hours per month.

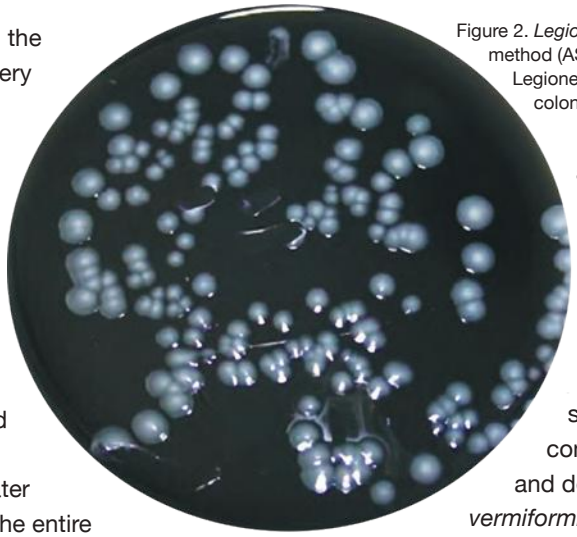

Figure 2. *Legionella* detected via the standard culture-based method (AS 5132:2017). The opalescent circles are the Legionella colony with each colony representing a colony forming unit (CFU).

Results

Legionella detection

Of the total samples, 21.7 per cent (*n*=36/ 166) were positive for VBNC *Legionella* and *Legionella* DNA (includes both alive and dead cells). With the novel method and qPCR returning the same positive results. However, the standard culturebased method (AS 5132:2017) only found 2.4 per cent (4/166) samples to be positive for *Legionella*. Therefore, of the 36 samples that were positive for VBNC *Legionella* using our new method, the standard microbiological culturing assay returned a false negative result for 32 of them (88.9 per cent) (Fig 2).

Relationships between *Legionella*, amoeba, and HPC

All samples positive for *Legionella* were also positive for free-living amoebae. This supports a previous study conducted in Australia that showed that *Legionella* presence in drinking water always co-occurred with amoeba.[9] These results demonstrate the important role that amoebae hosts play in the persistence of *Legionella* within hospital water systems. Future water management protocols aimed at controlling *Legionella* should consider incorporating treatments strategies that also target the control of amoebae.

Samples with a very high heterotrophic plate count (HPC ≥5 x 103 CFU/L) were also statistically significantly associated with high concentrations of Legionella DNA (alive and dead cells), VBNC *Legionella* and *V. vermiformis*. This supports the use of HPC as an indicator of high-risk microbial water quality. However, despite high concentrations of HPC associated with high concentrations of *Legionella*, no statistically significant associations were found with the lower concentrations. (Fig 3)

Relationships between microbes and water flow and temperature characteristic

As shown in Figure 4, temporary water stagnation arising through intermittent usage (<2 hours of usage per month) significantly ($p<0.01$) increased the amount of *Legionella* DNA, VBNC *Legionella*/*L. pneumophila*, and *V. vermiformis*; however, it did not significantly impact the HPC load. This supports guidelines that recommend routine flushing of outlets to manage *Legionella* within engineered water systems.[10]

No associations with temperature were identified. However, as this study averaged water temperatures across

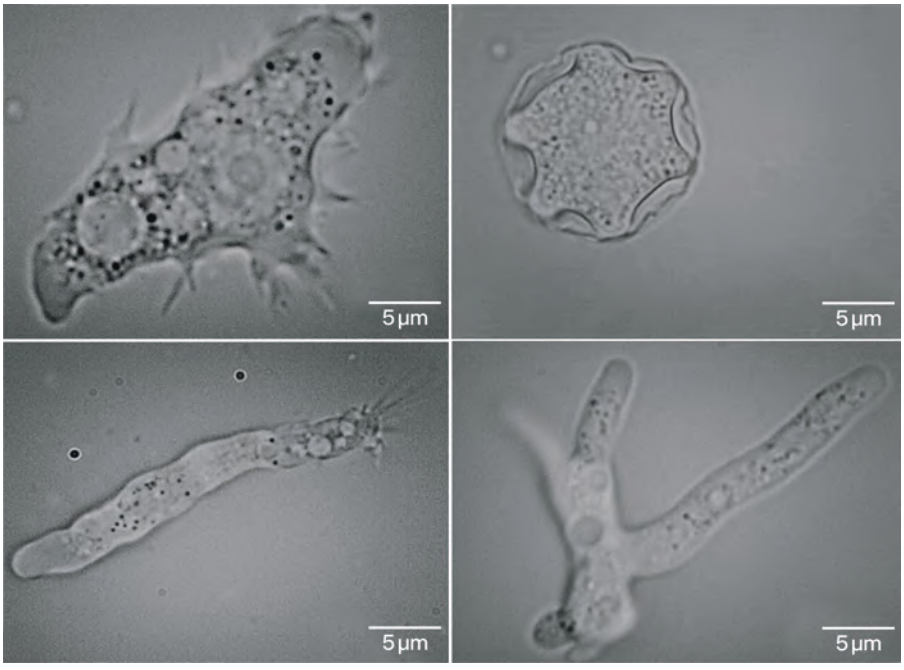

Figure 3. Amoeba found in drinking water samples are known hosts for Legionella.

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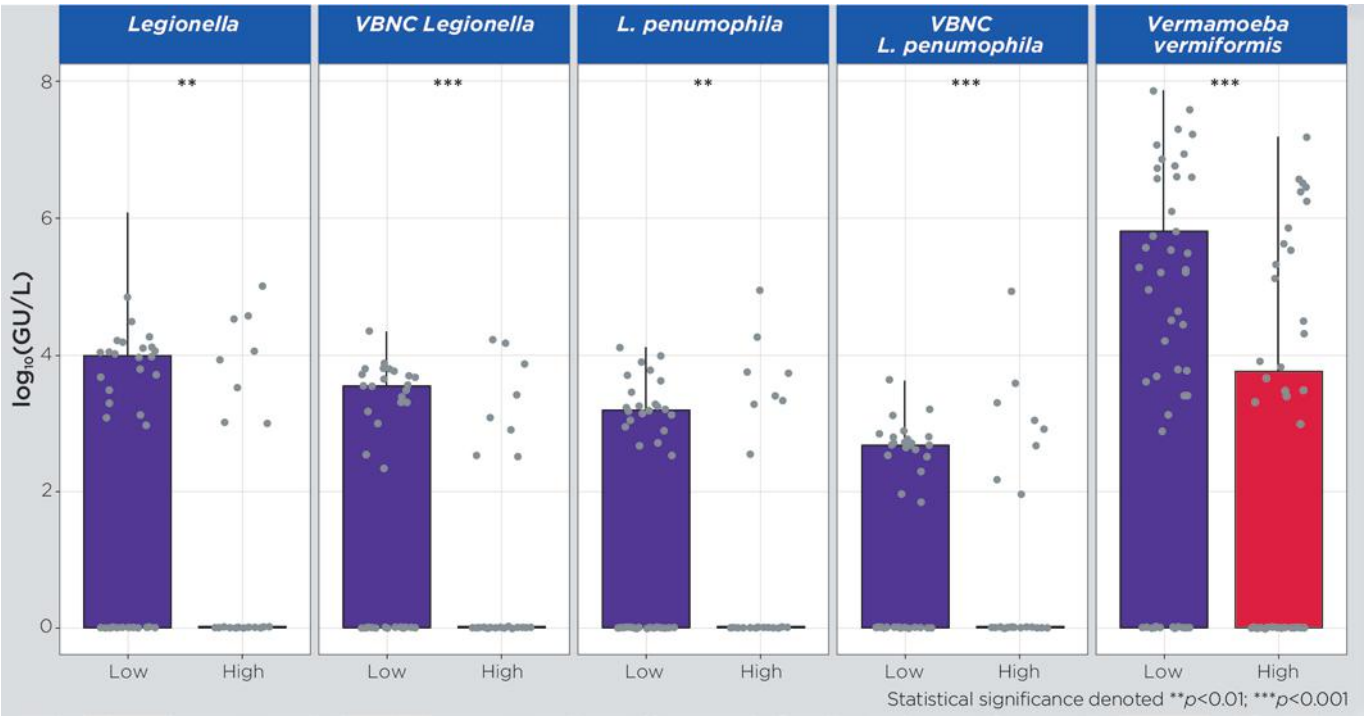

Figure 4. Relationship between intermittent water usage and the presence of *Legionella*/*Vermamoeba vermiformis*. X-axis represents total duration (hours) of flushing events recorded for one-month prior to sampling. Flushing was categorised into low; 0 to <2 hours, and high flow regime; ≥2 to 40 hours. Y-axis represents log_{10}(GU/L) of *Legionella*, VBNC *Legionella*, *L. pneumophila*, VBNC *L. pneumophila*, and *V. vermiformis* (Sourced from Nisar *et al* 2023).

one week or one month prior to sampling for both the hot and cold water pipelines/outlets, the water temperatures were more similar to each other than anticipated. This is likely to explain the lack of a statistically significant difference in *Legionella* concentrations associated with different temperatures. Future research with a larger dataset is needed to explore the temperature relationship further.

Conclusion

This study showed that the standard microbiological culture method used to detect *Legionella* returned a false negative result for 88 per cent of the samples that were found to contain VBNC *Legionella*. These VBNC *Legionella* are alive and pose a potential risk to humans. As all samples positive for VBNC *Legionella* were also qPCR positive, qPCR may be a more appropriate detection method for routine surveillance. However, future research is needed to investigate the concentrations of VBNC *Legionella* that pose a risk to public health to enable interpretation of these results to inform improved *Legionella* guidelines. This study also showed that the elimination of temporal water stagnation occurring at outlets through intermittent use is important for the management of *Legionella* in hospital water systems. This supports the enHealth Guidelines for *Legionella* control recommendation of routinely flushing outlets. It also demonstrated the use of a real time monitoring system for the management of *Legionella* that overcomes the limitations with current verification monitoring methods and the demonstrated limitations associated with the standard *Legionella* detection methods. Ultimately this proactive approach to routine monitoring and water management reduces the risk to end users.

I This article was adapted from: Nisar MA, Ross KE, Brown MH *et al*. Stagnation arising through intermittent usage is associated with increased viable but non culturable *Legionella* and amoeba hosts in a hospital water distribution system. *Front Cell Infect Microbiol* 2023; 13: 1190631 [https://www.frontiersin.org/ articles/10.3389/fcimb.2023.1190631/full].

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About the Authors

Dr Muhammad Atif Nisar recently completed a PhD in Environmental Microbiology at Flinders University. His research focused on the interaction between amoeba and Legionella and the role of VBNC Legionella in the management of this pathogen in high-risk settings.

Dr Kirstin Ross is a professor in environmental health at Flinders University. Her research is focused on anything in the environment that affects human health. She is interested in engaging with communities in environmental health issues, particularly with remote First Nations communities.

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James Xi is an electronics engineer at Enware Pty Ltd and a PhD candidate with Environmental Health at Flinders University. His research supports Enware's commitment as an industry leader and is focused on the use of sensor data and predictive modelling to control Legionella in premise plumbing systems.

Jason Hinds is the senior manager of research and development, design and engineering at Enware Pty Ltd, an 85-year-old manufacturer and distributor of high quality specialist plumbing and water delivery and management solutions. Jason is responsible for leading Enware's research and innovation strategies, managing their product portfolio and new product development initiatives.

Dr Harriet Whiley is an associate professor in environmental health at Flinders University and deputy director of the ARC Training Centre for Biofilm Research and Innovation. Her research is aimed at informing best practice control of pathogens in the environment to protect human health.

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UTILISING BIOPHILIA AND THERAPEUTIC GARDENS

Luciano Monza

Luciano Monza, former president and current board member of Asociación Argentina de Arquitectura e Ingenieria Hospitalaria (AADAIH), discusses the importance of therapeutic gardens in a modern hospital setting.

The term biophilia refers to the human need to be in contact with nature and other forms of life.

According to Moya and Cedrés de Bello1 "*… biophilia … originates from the Greek, 'bios' life and 'philia' love, literally meaning love for life*." They explain that the term was originally defined by Erich Fromm (1973), and afterwards developed by Edward Osborne Wilson (1984): "*According to Wilson's theory, people need to be in contact with nature since this is essential for psychological development. Satisfying this vital desire is equally important to the fact of establishing relationships with other people*."

While therapeutic gardens are not the only possible application of the biophilia concept in a building, they play a very important role as part of the strategies to provide a response to the need for a relationship between interior and exterior and between built environment and natural environment.

Background

Gardens, whether therapeutic and non-therapeutic, have had a significant place in hospitals throughout history. However, in the 20th century, they ceased to occupy a space in the project and in the reality of health care institutions.

Cooper Marcus and Barnes (1995) argue that as early as the Middle Ages, the concept of therapeutic garden emerged and that hospitals and monasteries had a recreational courtyard where residents found shelter, sun, and shadow.

NYBG explain that in medieval hospitals (12th to 15th centuries), more herbs and spices were grown in the hospitals than were purchased outside, and that gardens were one of the main elements of the hospital for three reasons:

- They provided plants for food and medicines.
- They provided good smells.
- Working in the garden was a therapeutic activity.

But even in the hygienist theories of the late 19th and early 20th centuries, as a consequence of the overcrowding in the cities produced by the industrial revolution, hospitals were conceived with an important articulation between the exterior and the interior. Natural light and sunlight were highly valued. For Campari (2009), the fundamental ideas of the hygienist thinking of the late 19th century in relation to disease as a social phenomenon, extended in the city of Buenos Aires to various fields of action, including the landscape intervention of green areas in hospital institutions, articulating a discourse and a practice between social, health, and public space. He mentions as significant events the epidemic diseases of cholera (1869) and yellow fever (1871) that occurred in Buenos Aires, which raised questions about the hygienic conditions in which the city found itself. But with the increasing technification of medical treatments and buildings (mechanical ventilation and artificial lighting), the concept of hospital as a healing machine and human body as a machine to be repaired in a workshop (with the consequent loss of patient's subjectivity), and functional relations as the determining element (if not practically the only one) for the project, hospitals began to have increasingly compact and extended buildings, and an increasing number of spaces without natural lighting and without contact with the outside.

Cooper Marcus and Barnes (1995) explain that in the 20th century, the largescale construction of hospitals, tall highrise development, and the prioritisation of cost-efficiency led to the disappearance of gardens except in chronic patient hospitals: "*… the therapeutic garden and its potential healing benefits have been lost to high technology, expensive drugs and increasing medical specialization*."

In the words of Briones (2010), " *… air conditioning has replaced natural ventilation, balconies and terraces have disappeared, and nature has succumbed to parking lots*."

Severtsen synthesises it in the concept of 'cure over care', as the idea that the development and advancement of medical treatments was occupying the entire design of the hospital space displacing other architectural resources associated with a more holistic conception of patient care. However, new theories have demonstrated the importance of natural light and outdoor visuals in patient recovery. At the same time, the relationship with the outdoors also becomes very important for staff who work many hours in the building and often under conditions of significant pressure and stress.

Several authors place this paradigm shift from the 1990s onwards, when people started talking about patient-centred design.

Effects

All the literature reviewed mentions the positive effects of therapeutic gardens on patients, caregivers and staff.

For example, Cooper Marcus and Barnes (1995) conducted case studies where their main conclusions were:

- 75 per cent used them at least once a day.
- More than half used them to relax, eat, talk, and walk around.
- 95 per cent 'felt different' after having been in the garden.
- 78 per cent felt more relaxed, less stressed, calmer, and more content.
- Most of them valued trees and plants (69 per cent); auditory, olfactory, and tactile sensations (58 per cent); and psychological and social aspects (50 per cent).
- 60 to 90 per cent experienced a pleasant decrease in energy.
- Between 4 and 11 per cent experienced a change in their spiritual or religious state.

Cooper Marcus and Barnes therefore conclude that the external therapeutic gardens:

- Are used for therapeutic and emotional healing.
- Generate positive expectations and attitudes.
- Improve recovery from illness.
- Help staff return to work more relaxed and refreshed.
- Improve staff confidence, thus increasing productivity and community satisfaction with the hospital.
- Encourage patients, visitors, and staff to go to the garden to feel better.

They also mention other studies (Ulrich, R. 1979, 1984, 1986; Honeyman, M. 1987; Hartig, T. *et al*. 1990) showing that greenery has a high correlation with stress reduction, and demonstrating that:

- Recovery is more rapid when the views are of nature and not of a building;
- Participants in gardening tasks report improved mood, tranquillity, and sensory enjoyment.
- There are psychological benefits, both in functioning and behaviour, in both long and short stays, as a result of being in a natural setting.
- Patients prefer to go to an outdoor environment when they are troubled or upset.

In a subsequent paper in 2007, Cooper Marcus explains that the responses suggested that the gardens were important because they represented an absolute contrast to the experience of being inside a hospital, given the:

- Domestic versus institutional scale.
- Artisanal versus the manufactured.
- Rich versus limited sensory experience.
- Organic forms versus straight lines.
- Places to be alone versus places with no privacy.
- Fresh air versus air conditioning.
- Evocation of the larger life and the cycle of life versus thoughts of anxiety, illness, and death.

In her analysis, she makes a very important distinction in arguing that 'healing' is not the same as 'cure'. While the Spanish translation of both terms may be 'cure', we can interpret that 'therapy or treatment' (healing) is not the same as 'cure'. That is why it is appropriate, in Spanish, to speak of therapeutic gardens and not healing gardens.

Severtsen, quoting Ulrich (1981), says that the sight of nature has been shown to produce faster postoperative recovery times, less negative comments about staff, less medication, and fewer postoperative complications. In his writing, every garden is therapeutic, but to be so-called, a therapeutic garden has to give an idea of stress restoration, and have a positive effect on patients, visitors, and staff.

Campari explains that in the hospitals of the early 20th century in Buenos Aires, conceived under hygienist criteria, "*… the beneficial action of natural light, ventilated*

environments and the height of the buildings was evidenced, which were favoured by the isolated distribution of the wards and the appropriate use of greenery as a surrounding mantle of external sanitation."

For Briones (2010) the therapeutic process is composed of four phases:

- **Daytime**: invites physical and visual exploration. Transitions highlighted with hidden views, changing the orientation, and shelters of different climates, light and shadow, varying degrees of enclosure to create movement, and distancing vision, thus trying to change the painful perspectives of patients.
- **Sensory awakening**: variety of noninvasive sensory stimuli, and opportunities to stop and enjoy the sensations. Attention to fragrances and wind, which are not normally noticed. This brings awareness to the moment and reduces the need for other conflicting mental activity.
- **Self-awareness**: apply the concept of shelters and other protective measures to create physical and psychological areas that stimulate reflection or healing.
- **Spiritual attunement**: incorporate a sense of preciousness, through the ephemeral, unusual, and intriguing, or the connection with other species (exotic or domestic) and to stay away from present problem by extending one's presence into the future.

Types

Although there are different classification criteria, a first conceptual classification can probably be made between contemplative gardens and gardens for use.

In the second classification, gardens for use, Briones (2010) divides them into two broad categories: restorative and rehabilitative.

- **Restorative garden**: for stress reduction, emotional support, cognitive balance, and increased sense of wellbeing. They can be universal or focus on small groups (children), or a specific stress (cancer). Subtypes: sanctuary, meditation, and ritual gardens.
- **Rehabilitation gardens**: facilitate the development or maintenance of physical or cognitive skills through interaction with plants. Secondary benefits include improved social and psychological skills.

Cooper Marcus and Barnes (1995) also speak of contemplation and use, but as two ways of using them, defining four possible implications: visual, horticultural therapy, simply a place to stay, and stress reduction.

But later they produce a much more exhaustive and broader classification of gardens or outdoor spaces, more associated to the place they occupy in the composition of the architectural space:

- Landscape grounds – open space between buildings that articulates the whole.
- Landscape setback – in front of a building and usually has no use.
- Front porch – at the entrance, with a place to go down and stay.
- Entry garden – in front of a building but usually used as a porch or gallery.

- Courtyard – the centre / core of the complex, visible and with activities.
- Plaza – areas for use, equipped and generally dry.
- Roof terrace – type of balcony, with construction on one side and open on the other sides.
- Roof garden – on the roof of a building.
- Healing garden – indoor or outdoor spaces specially designed for therapeutic purposes.
- Meditation garden – a small, quiet space identified for meditation.
- Viewing garden – not usable, only for viewing.
- Viewing/walk-in garden – mainly for contemplation, but some people can enter.

Design recommendations

The design recommendations are varied and broad. Cooper Marcus and Barnes (1995) divide them into three groups:

1. Site location and design

- Contrast with the interior to emphasize the feeling of 'going away'.
- Design them with awareness of illness and the necessary microclimate.
- Take into account feelings of safety, serenity and confidence.
- Variety depending on types and ages of users.
- Visible and accessible from the places where people are usually located.
- Privacy and filters to the street.
- Visible for staff to control.
- Dividing the space with different situations.
- Complementarity with the interior.
- Balconies or garden terraces are an option for people with mobility difficulties.
- The design has to be easily understandable to avoid confusion.
- Flooring needs to be safe and spacious.

2. Greenery, equipment, and details

- Presence of greenery and living elements.
- Stimulation of the senses.

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- Generate a plant bellows in relation to the interior rooms.
- Comfortable places to sit.
- Tables and chairs that can be accommodated.
- Protection from the sun and wind.
- Take advantage of the views.

3. Maintenance

Briones (2010), when differentiating therapeutic gardens as restorative gardens and rehabilitation gardens, formulates different design recommendations.

For the restorative garden, he defines the following design guidelines:

- The prosperity of plants is one of the most significant factors in the perception of the healing benefits of nature.
- Particularly harmful can be designs that are susceptible to ambiguous interpretations, because more often than not they will be interpreted negatively by users who are not quite well or still under stress.
- Plants with irritating sensory characteristics, or design where the amount of paving and structures exceeds the number of plants, should also be avoided.

In turn, he formulates the following design guidelines for rehabilitation gardens:

- These gardens are designed to provide experiences that increase or support the highest levels of functionality and well-being to people. People engaged in gardening or routine maintenance of a garden tend to improve and reinforce their pre-existing skills, as well as gaining and renewing physical and mental skills.
- It must be physically and psychologically safe.
- It should provide three levels of engagement: activities, opportunities, and challenges.
- Evaluating these components for physical and psychological improvement can serve as a structure for design goals and can help in the incorporation of appropriate elements for proper landscaping. IFHE

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About the Author

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Luciano Monza is a former president and current board member of Asociacion Argentina de Arquitectura e Ingenieria Hospitalaria (AADAIH) and has more than 30 years of experience in the planning, design, and management of health facilities in the public and private sectors. He is a PhD candidate and architect, a specialist in health facilities from UBA, and a specialist in social sciences and health from CEDES FLACSO. Luciano is also director of the postgraduate course on Health Buildings Project AADAIH FADU UBA and a postgraduate lecturer in Buenos Aires, Barcelona, La Plata, Porto Alegre, Rio de Janeiro, and Sucre.

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