PRS

The world's leading UVC Solution for
Commercial Air Handling Systems

SAFE AIR RECIRCULATION IN HEALTHCARE SETTINGS

Improving patient outcomes, energy efficiency, and sustainability

Pathogen Reduction Solutions Ltd
2nd October 2024

PATHOGEN
REDUCTION SOLUTIONS

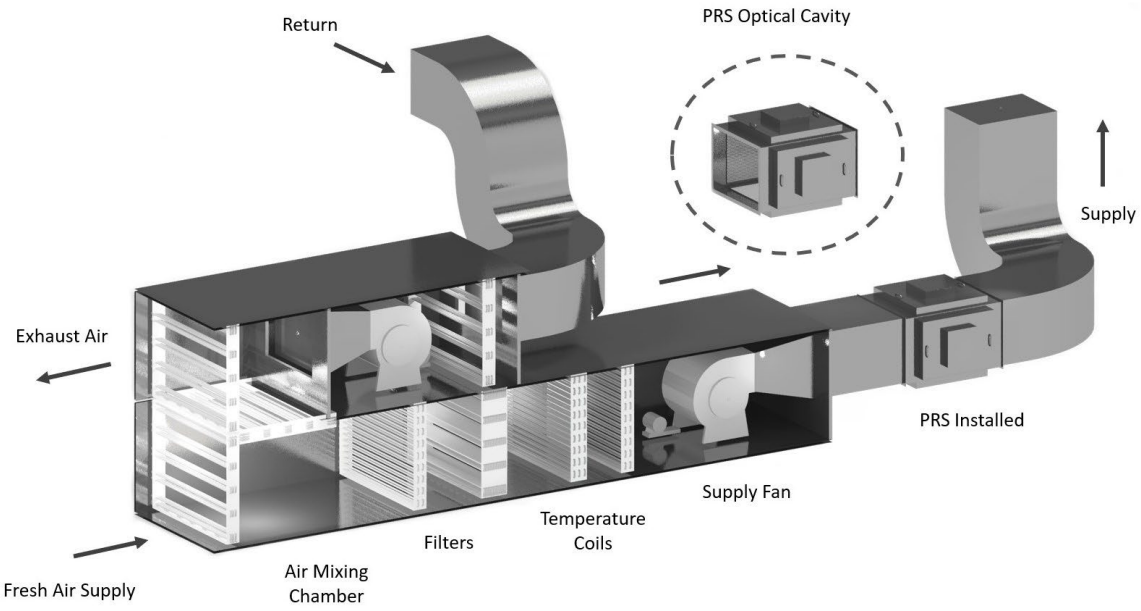
INTRODUCTION

PRS provides world-leading UVC-based air sanitisation for HVAC in large commercial buildings. Comprehensive BSL3 lab and live site testing consistently demonstrate the system's efficacy.

PRS allows safe recirculation of air. **Safely** i**ncreasing recirculation rates delivers many important benefits** to hospitals:

Key Benefits for Healthcare:

- ✓ **Reduction of airborne pathogens** delivers:
  - ✓ Improved patient outcomes
  - ✓ Less intra-ward transmission
  - ✓ Higher staff confidence and productivity
- ✓ **Increased air recirculation** provides economic benefits:
  - ✓ Considerably less HVAC energy consumption
  - ✓ Reduction in amount of polluted external air used
  - ✓ Lower levels of mould



NB: PRS systems will comply with the requirements as set out in the SHTM 03-0

Air is continually sanitised whether external or remixed!

BENEFITS TO HEALTHCARE OPERATIONS

Health and operational benefits both provide significant financial benefits:

HEALTH & SAFETY

- Reduction in HCAIs, particularly respiratory
- Less reliance on external polluted air
- Lower levels of VOCs

OPERATIONAL ECONOMICS

- Significant reduction in HVAC energy use
- Increase in staff productivity
- Future pandemic protection

FINANCIAL

£

ROI typically > 30%

ROC typically ~ 2 years

PRS

TESTING AND PERFORMANCE

INNOVATIVE BIOANALYSIS

creating solutions | getting results

COMPREHENSIVE LAB TESTING

Efficacy testing was carried out in a California BSL-3 using live viruses and bacteria in air moving at 6 m/s (residence time of 0.17 secs) in a single pass. This average **airspeed used was far in excess of the 2.54 m/s suggested in ASHRAE 185.1**.

To enable performance data extrapolation Measles was tested with 1 deck of lamps as well as with the standard 4 decks.

Other differentiations included the bacteria, Mycobacterium Parafortuitum, being tested with 2 decks of lamps, and the black mould, Aspergillus Niger, being tested at an airspeed of 1 m/s.

INNOVATIVE BIOANALYSIS
creating solutions | getting results

SINGLE PASS INACTIVATION:

Pathogen	Active Decks	Airspeed	Reduction
SARS-CoV-2	4	6 m/s	99.997%
Influenza A	4	6 m/s	99.999%
Measles	4	6 m/s	99.99%
Measles	1	6 m/s	82.66%
Micrococcus Luteus	4	6 m/s	85.65%
M. Parafortuitum	2	6 m/s	99.20%
Aspergillus Niger	4	1 m/s	69.27%

This single pass testing far exceeds standards set by ASHRAE 185.1 and ISO 15714.

BSL-3 Lab Testing

1. **Viruses**:
   a. SARS-CoV-2
   b. Influenza A
   c. Measles
2. **Moulds**:
   a. Aspergillus Niger
3. **Bacteria**:
   a. Micrococcus Luteus
   b. Mycobacterium Parafortuitum

COMPARATIVE TESTING

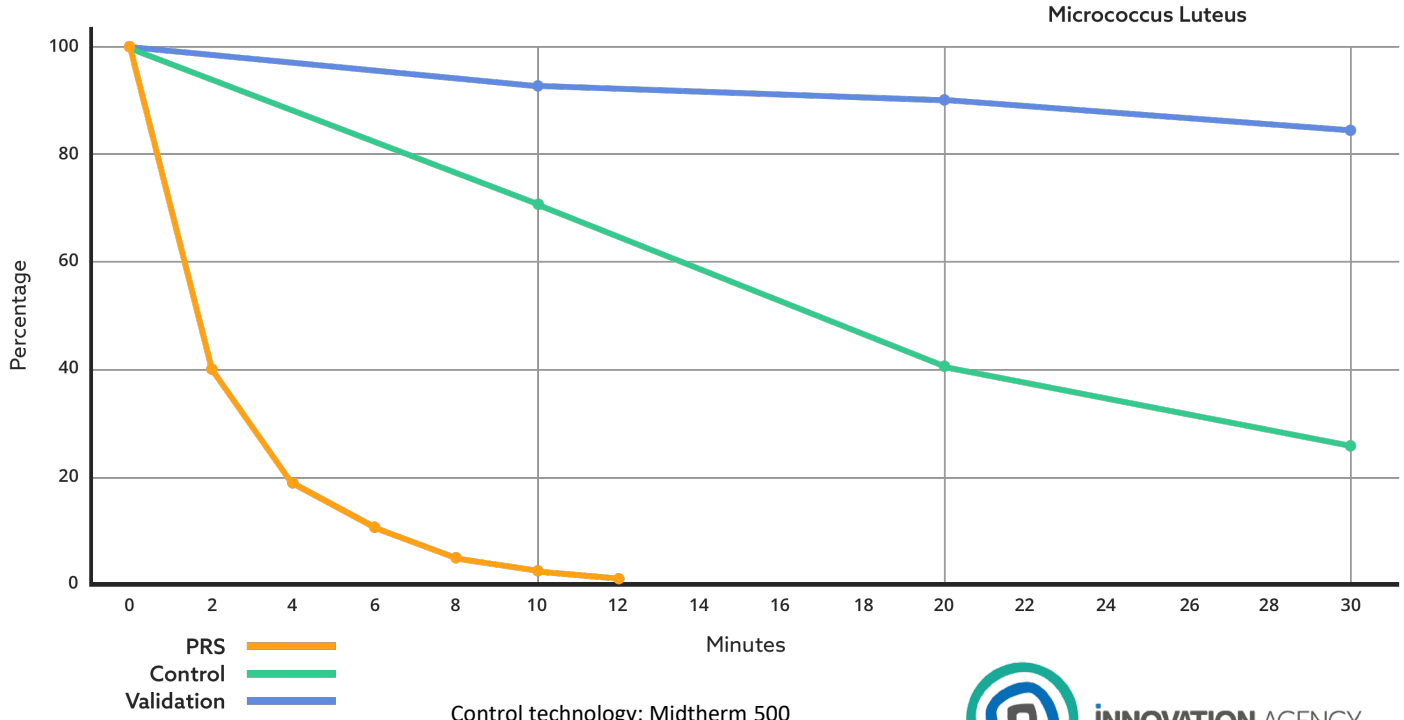
Following the PRS presentation at the 2022 **NHS IPC Conference** in Birmingham we worked with Prof Tony Fisher of University of Liverpool and Frank Mills, a consulting engineer to NHS England, on comparative technology testing.

Using the coast-down method, a PRS unit was tested seen against the best technology they had come across to date:

PRS

OUTPERFORMED

BY 10X



Control technology: Midtherm 500

INNOVATION AGENCY

PATHOGEN SENSITIVITY RATIO

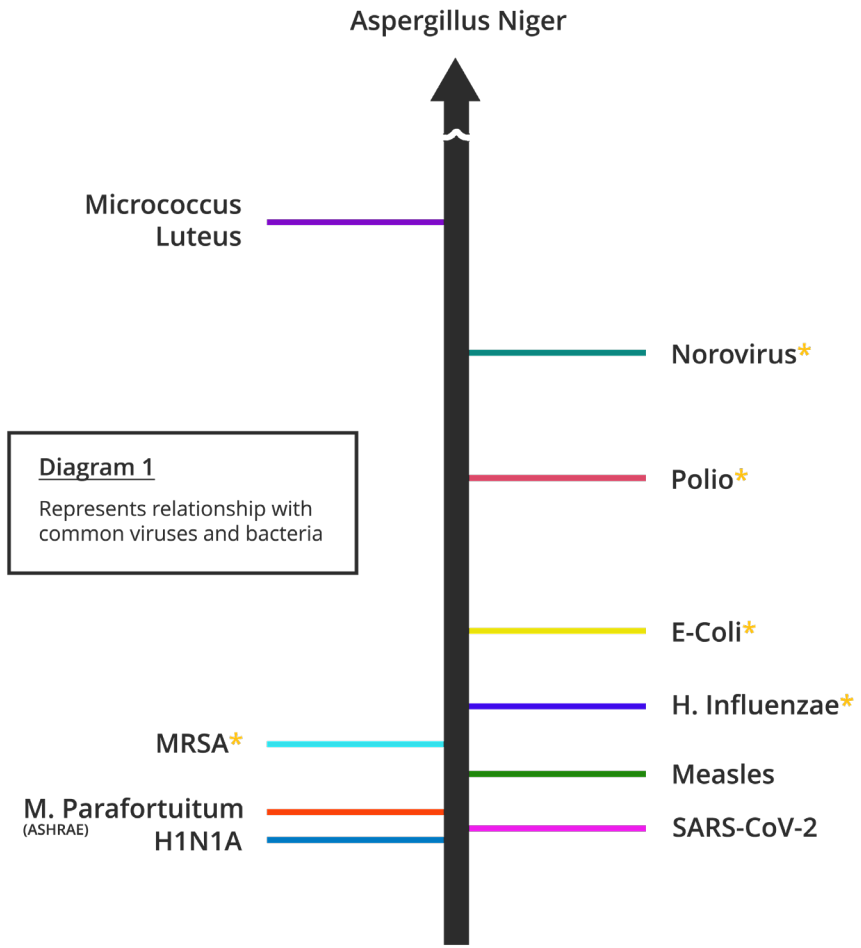


Diagram 1

Represents relationship with common viruses and bacteria

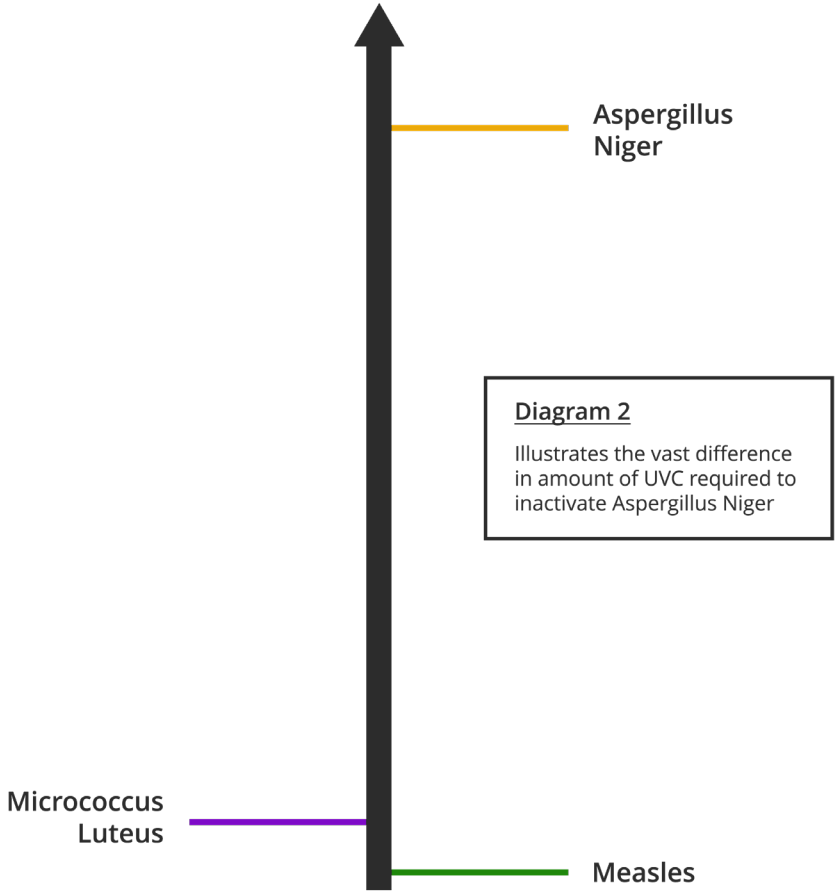


Diagram 2

Illustrates the vast difference in amount of UVC required to inactivate Aspergillus Niger

Key: Sensitivity ratio representation of quantity of UVC 254nm required for the inactivation of given pathogens in moving air in a single pass. Tested in a BSL3 Lab using a PRS system 14040. Data applicable to PRS optical cavity configuration only.
*Not tested – tabulated from Kowalski UVGI Handbook

PILOT INSTALLATION
CLIFFORD CHANCE

CLIFFORD CHANCE: INITIAL TESTING

In August 2023 PRS units were installed on the 22nd floor of their headquarters in Canary Wharf. Using the similarly configured 21st floor as a control, third party testing monitored the conditions over the pre- and post-installation phase:

Sample date (11am)	22 August	22 August	23 August	23 August	30 August	30 August
Building Floor	21st – control	22nd – **NO PRS**	21st – control	22nd – with PRS	21st – control	22nd – with PRS
TVOC's	253	582	301	111	700	136
Occupancy	100 (53%)	102 (63%)	62 (33%)	59 (36%)	49 (26%)	52 (32%)
Sickness (August)	84 (0.48 avg. pe)	43 (0.26 avg. pe)	84 (0.48 avg. pe)	43 (0.26 avg. pe)	84 (0.48 avg. pe)	43 (0.26 avg. pe)
Other factors	-	-	-	-	-	-

CLIFFORD CHANCE: COMPREHENSIVE TESTING

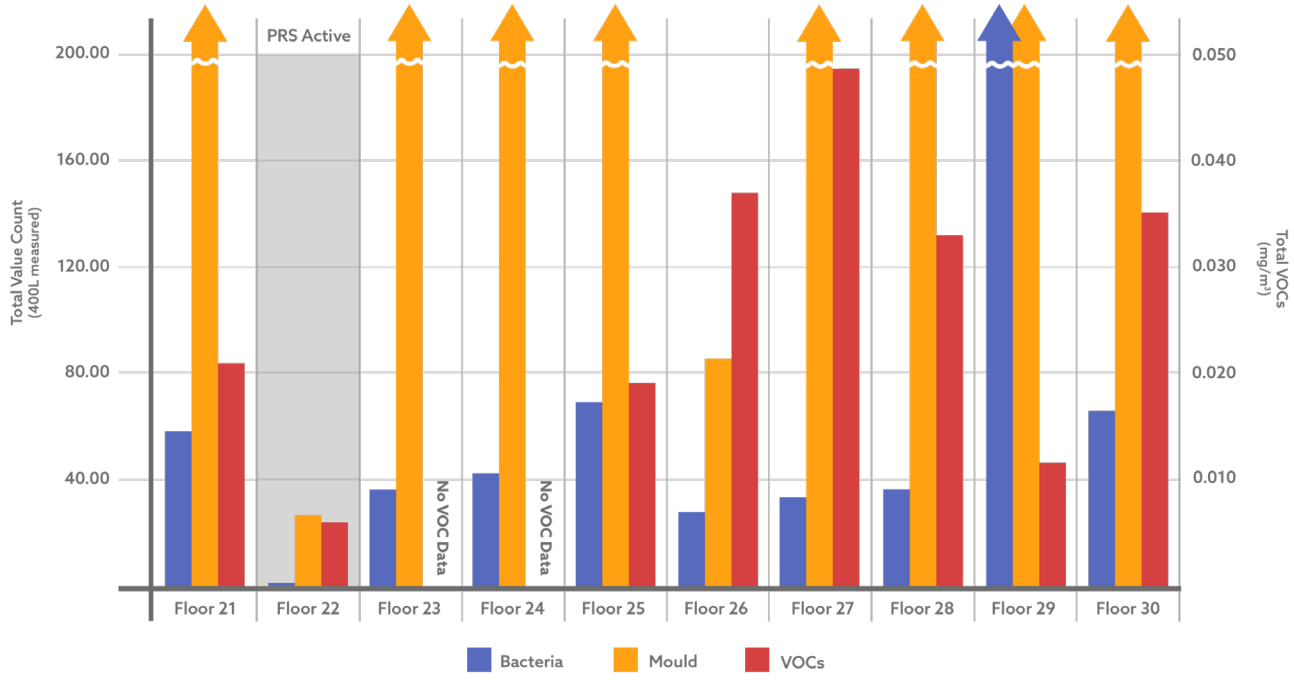
Comprehensive testing in November 2023, covering all Clifford Chance floors, produced compelling results:

- ✓ Virus testing is not possible in a non-laboratory setting but performance against bacteria is a suitable proxy
- ✓ The significant mould present on other floors was easily handled by PRS on the trial floor
- ✓ Testing for total VOCs* showed significant reductions

<u>This performance clearly demonstrates:</u>

1. Outstanding efficacy of PRS air sanitisation technology
2. The need for building pathogen resiliency ahead of current and future challenges

NOVEMBER 1ST, 2023 RESULT - INDOOR AIR QUALITY SUMMARY



Future testing will determine the exact performance against the main VOCs.

CLIFFORD CHANCE: EXTERNAL AIR QUALITY

The notion of **'fresh' air use in healthcare settings needs to be reconsidered**, particularly in metropolitan areas. External air in cities is neither fresh nor clean.

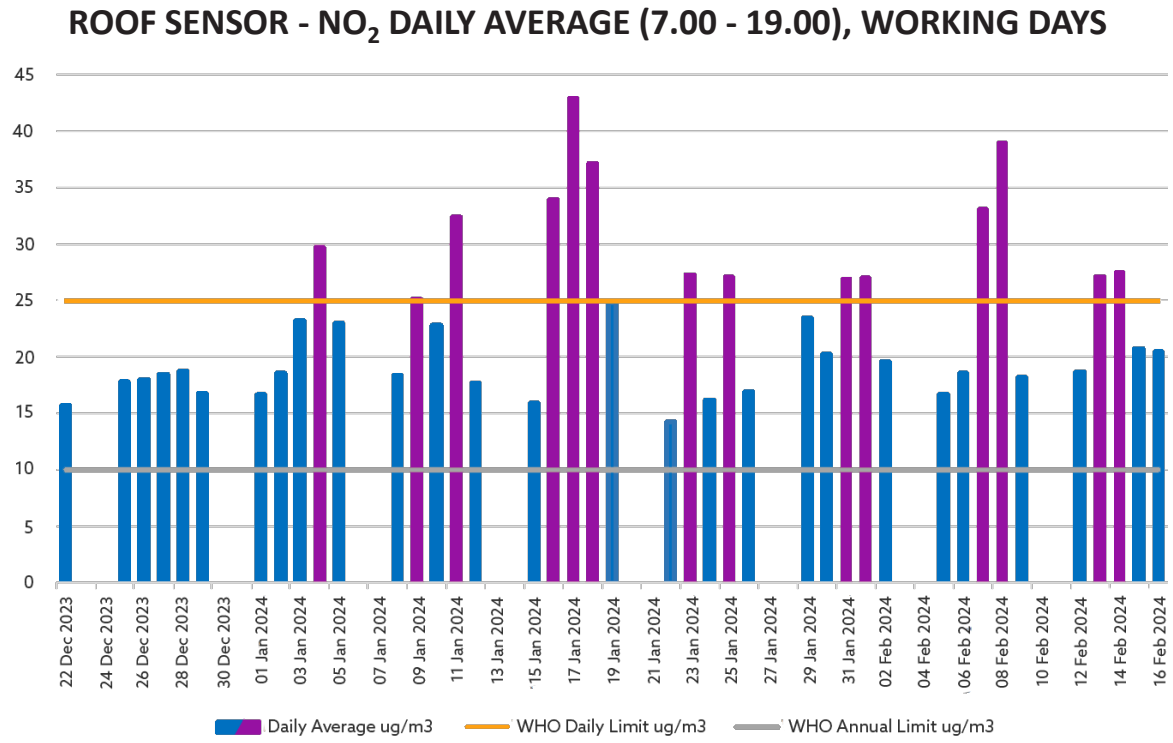
Rooftop testing at Clifford Chance's building found that **levels of NO_2 were often over WHO guidelines**.

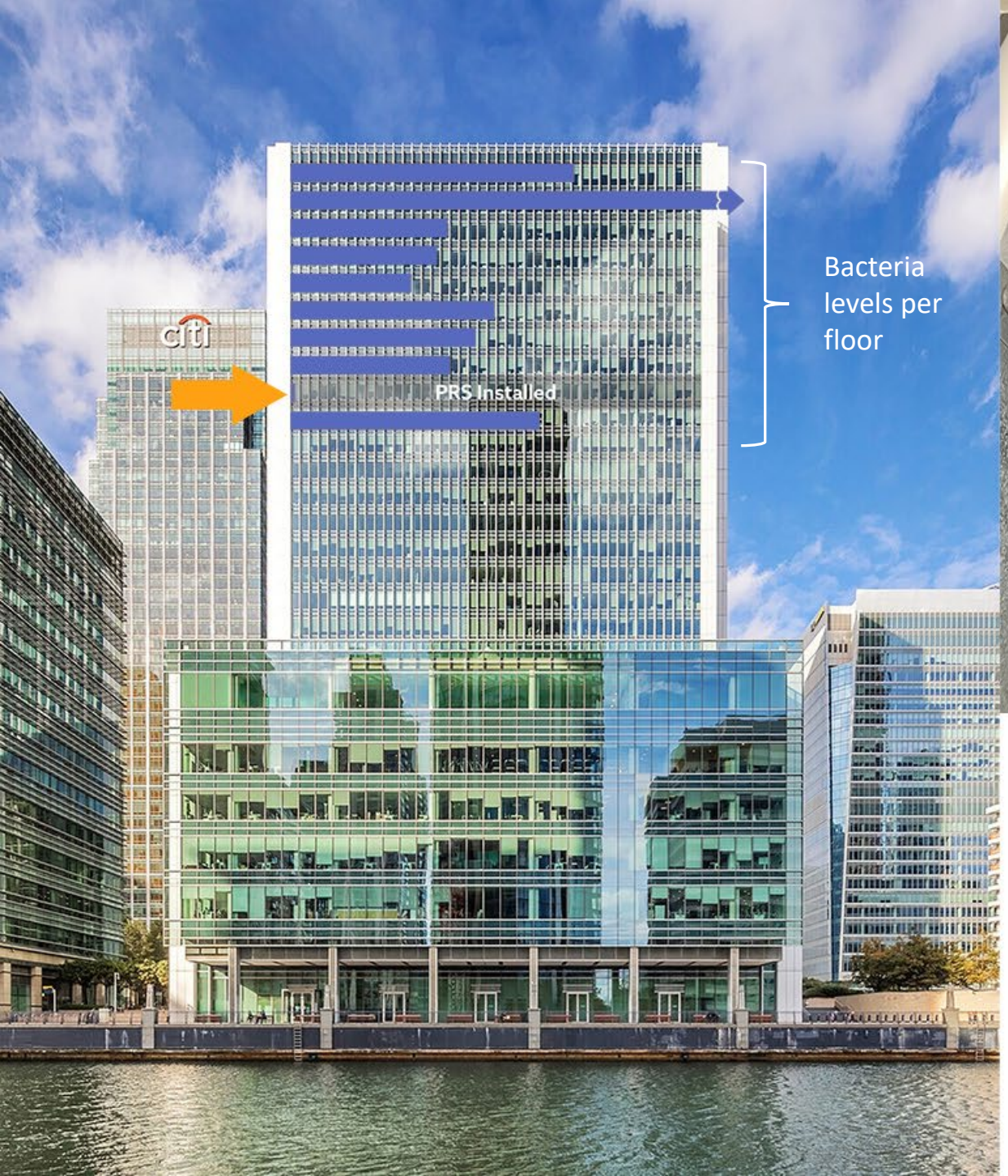
Increasing safe air recirculation reduces the reliance on polluted external air.

Air Pollution: Key Facts

- ✓ Over 50% of our exposure to air pollution occurs indoors
- ✓ We typically spend over 90% of our time indoors
- ✓ EPA* estimates that exposure to external pollutant concentrations are 2-5 times higher indoors
- ✓ UK has highest lung disease levels in western world; respiratory hospital admissions up 2x in the last 20 years

Environmental Protection Agency (US)





Installation Notes:

- ✓ PRS system built for life of the building (20-30 years)
- ✓ Retrofit installation of 2 PRS units (east & west AHU)
- ✓ Removing existing metal trunking and replacing with PRS: 3 hours per unit
- ✓ Commissioned and fully certified within 4 days
- ✓ Ongoing annual maintenance includes air sampling, cleaning, and lamp changes

PRS PROPOSAL
MONKLANDS HOSPITAL

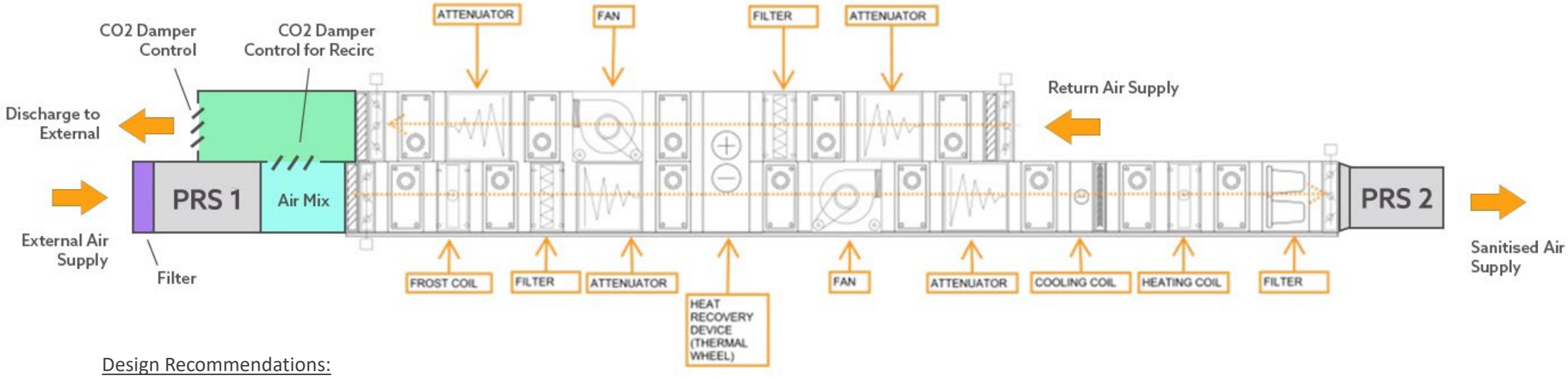
PROPOSAL: HOSPITAL SOLUTION

PRS were invited by the Head of IPC at NHS Lanarkshire to propose a solution to a problem with Aspergillus Niger in Ward 15 of Monklands Hospital.

Following initial dialogue and a site visit **a scope of work framework** was decided:

- ✓ Mechanical ventilation required as a precursor
- ✓ 10 air changes per hour required
- ✓ Patient areas need to maintain positive pressure of +15 Pa
- ✓ “Fresh” air to comprise at least 20%
- ✓ Separate intakes and discharge points
- ✓ BMS integration
- ✓ IAQ monitoring
- ✓ Must support 40 person capacity, ideal ward target being 66
- ✓ Conforming to SHTM-03

PROPOSAL: MONKLANDS HOSPITAL



Design Recommendations:

1. First pass filter: Merv 9
2. Secondary filters: Merv 13 (or V cell)
3. PRS 1: initial inactivation of Aspergillus Niger
4. PRS 2: final pathogen inactivation of mixed air
5. Add UVC to heat recovery coil care (thermal wheel)
6. Manage to CO_2 target of 850 ppm

PRS systems will comply with the requirements as set out in the SHTM 03-0, and in particular SHTM 03-01, sections 9.120 and 9.184 which relate to air recirculation and air pressure respectively.

HEALTHCARE
VALUE PROPOSITION

VALUE PROPOSITION: HEALTH & SAFETY

Improving the biological environment has many advantages in healthcare settings. Reduced levels of airborne pathogens and contaminants will improve operational efficiency.

Using **NHS England data*** we can project the financial impact of reducing HCAIs in a **hypothetical 200 bed inpatient hospital**:

	Total	200 Beds
Adult Admissions	13,800,000	29,870
Adult Beds	92,200	200
Adult Bed Days	33,653,000	72,842
HCAIs	653,000	1,413
Deaths due to HCAIs	22,800	49
HCAI Bed Days	5,600,000	12,121
Total Cost of HCAIs	**£2,100,000,000**	**£4,545,455**
HCAIs per Bed Day	16.64%	
HCAIs per Admission	4.73%	
Cost per HCAI	£3,216	

Key Causes of HCAIs:	
Respiratory Tract Infection	22.8%
Urinary Tract Infections	17.2%
Surgical Site Infections	15.7%
Clinical Sepsis	10.5%
Gastrointestinal Infections	8.8%
Bloodstream Infections	7.3%
PRS Performance Assumption (Against respiratory infections only)	90%
Performance: 200 Bed Hospital	
Lives Saved	10
Cost Saving	£932,727

*NHS England: Gen & Teaching Adult Admissions 2016/17
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7045184/

VALUE PROPOSITION: OPERATIONAL ECONOMICS

The guarantee of safe indoor air allows a significant increase in air recirculation, which will reduce HVAC energy consumption considerably.

Using **NHS England estates data from 2022/23*** we can project the financial impact of reducing energy consumption in a **hypothetical 200 bed hospital**:

Energy Use	Barts NHS Trust**	200 Beds
Electricity Use @ £0.2815 / KWh	£19,513,056	£2,168,117
Gas Use @ £0.0766 / KWh	£12,287,210	£1,365,246
Oil Use @ £0.0737 / KWh	£23,398	£2,600
Other Energy Use	£1,673,456	£185,940
Total	£33,497,120	£3,721,902
HVAC Energy Cost (Est. 50%)	£16,748,560	£1,860,951
Benefit of PRS Application:		
Reduction in Energy Cost (Est. 15%)	£2,512,284	£279,143

The estimated 15% reduction in energy use is based on our findings at Clifford Chance.

We expect energy saving to be considerably higher, particularly for facilities that operate on minimal recirculation.

Subject to the age and configuration of the building we believe **savings are more likely to be in the 20-30% range**.

*NHS England - Estates Return Information Collection (ERIC) 2022/23
https://digital.nhs.uk/data-and-information/publications/statistical/estates-returns-information-collection/england-2022-23

**Barts NHS Trust data was used as the sample data due to the 4 hospitals in the Trust having large inpatient facilities. The combined inpatient beds within these hospitals is around 1,800 so this figure has been used as the foundation for the 200 inpatient-bed projection.

VALUE PROPOSITION: INVESTMENT RETURN

According to Skanska's data from their PFI project for the Barts Trust there are around 1,200 patient beds serviced by 240 AHUs across the two hospitals. Calculations using this information allow us to project the cost of a PRS installation and the respective financial returns:

Barts Trust (2 Hospitals)* **	**Total**	**200 Beds**
Patient Beds	1,200	200
AHUs	240	40
Patient Beds per AHU	5	5
PRS Unit (inc. Installation) per AHU		£65,000
Total Installation Cost		**£2,600,000**
Annual Savings Projection		
Reduction in HCAI associated costs:		£932,727
Reduction in HVAC Energy costs:		£279,143
Total Annual Saving:		***£1,211,870***

RETURN:

ROI = 37%

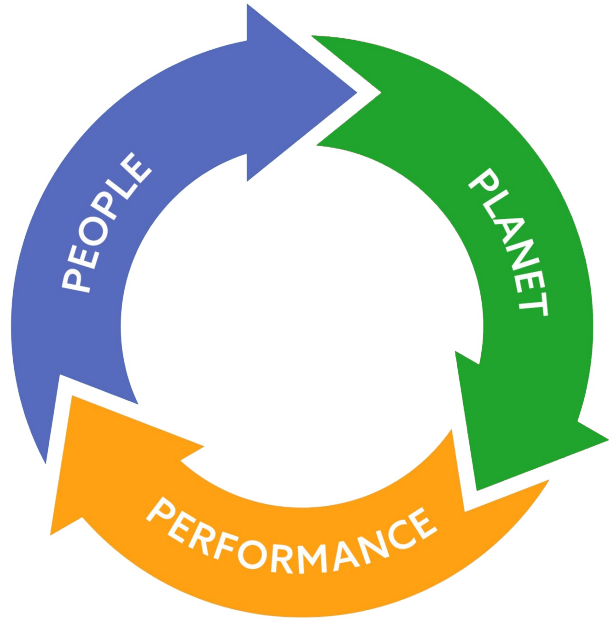
ROC = 2.15 years

***Barts NHS Trust data taken from Skanska PFI document for St. Bartholomew's and Royal London hospitals Project information indicated that on completion there were 240 AHUs and 1,248 patient beds across the two hospitals. For simplification, the number of beds has been rounded down.

CONCLUSION

We understand that changing long standing ‘fresh’ air protocols within healthcare settings will meet resistance, but there are compelling reasons why PRS is a solution:

- ✓ PRS has clearly demonstrated safety and efficacy in laboratory and commercial built environments
- ✓ Improved patient outcomes will improve operational efficiency and effective capacity
- ✓ Investment is independently financially justified with an estimated ROI of 37% and return on capital of around 2 years
- ✓ Energy efficiency will help meet NHS emissions targets and improve environmental sustainability



We need a trial hospital setting to further our case for the change to safe air recirculation.

PRS technology (or others with similar performance) can seriously improve patient outcomes within an economically favourable solution.

PRS

DESIGNED & MANUFCTURED

THANK YOU

Patents

Granted:

GB 2601361 B
GB 2614287 B

Applications:

UK: 2208032.9
Worldwide: PCT/GB2021/0503091

PATHOGEN
REDUCTION SOLUTIONS