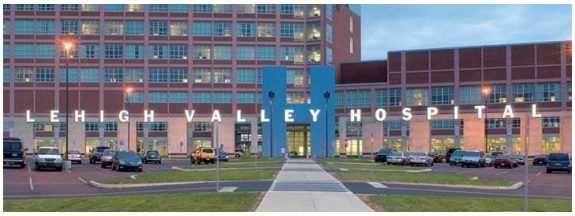
Unique Green Attributes of Steril-Aire UVC Emitters

Steril-Aire UVC emitters have been successfully deployed in many green facilities around the world, helping facility owners improve their indoor environmental quality, enhancing building occupant health and well-being, saving energy and water, and protecting vital assets.

Listed below are **studies** conducted by **independent third parties** and **researchers**, assessing the efficacy of Steril-Aire UVC systems in microbial disinfection and restoration of air-conditioning system efficiency. The positive results of these case studies are a testimony to Steril-Aire's **germicidal effectiveness** in transforming facilities into **healthy**, **productive** and **energy-efficient assets**.

A. <u>Unparalleled IAQ and Disinfection Performance in Critical Facilities</u>

A1. Lehigh Valley Hospital IVF (In Vitro Fertilization) Lab, USA



A 7 ½ year study conducted in the **In Vitro Fertilization Laboratory** of the Lehigh Valley Hospital and Health Network found that the use of Steril-Aire UVC emitters installed in the HVAC system had a **clinically significant impact** on **clinical pregnancy rates (CPR)**. The high intensity ultra-violet irradiation from Steril-Aire UVC emitters **greatly reduced** the **"bio-burden"** within the IVF lab, resulting in **18.2% increase in pregnancy success**.

A2. Women and Children's Hospital of Buffalo, Buffalo, NY, USA

A 2½ year, peer-reviewed study shows a **greater than 5 Log microbial load reduction per square centimetre of HVAC coil in just 6 days!** This study documents significant reductions in VAP (Ventilator-Associated Pneumonia) and a decrease in antibiotic use in NICU (Neonatal Intensive Care Unit) high-risk patients as well as **medical savings of more than US$500,000 in the first year**.

This study demonstrates that Steril-Aire UVC emitters eradicate microbes in the central cooling coils and components of the HVAC and **decrease the microbial load of the NICU environment**. Many of the bacteria eliminated were **Gram-negative bacilli** known to be associated with **serious nosocomial infections** in the NICU.

A3. Muskogee Community Hospital, USA

Steril-Aire UVC emitters were installed in 77 air handling units that serve patient areas. Specially designed ceiling-mounted UVC emitters were also installed in surgical and procedural areas for after-hours disinfection. The Oklahoma Hospital Association study in this hospital documented **zero HAIs (Hospital-Acquired Infections) over a span of 21 months**, a feat seldom seen in hospitals anywhere in the world.

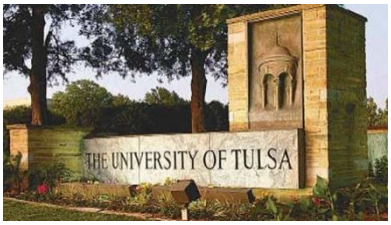
A4. Tan Tock Seng Hospital, Singapore

In 2015, airborne bacteria tests conducted at two AHUs at Tan Tock Seng Hospital by an Independent SAC-SINGLAS accredited laboratory confirmed the **inactivation of 90% of airborne bacteria** through the Steril-Aire UVC emitters in the AHUs. This is the first time such tests have been conducted in a hospital in Singapore to demonstrate the effectiveness of Steril-Aire UVC emitters in destroying airborne bacteria in actual operating hospital environment.

A5. Protection of Priceless Historic Leonardo da Vinci Atlantic Codex Drawings, Italy

The **Ambrosiana Library** in Milan which has guarded and preserved the **Leonardo da Vinci collection** since 1637, is bringing thousands of drawings out of the vault and unbinding them for their first-ever public display in Milan and later in exhibitions all over the world. After extensive research, Giorgio Ricchebuono, president of the Cardinal Federico Borromeo Foundation, determined that **Steril-Aire UVC technology** offers the **best option for preserving these 500-year-old documents** against the **potential ravages of mould and bacteria** that travel through building air-handling systems.

A6. Mould Study in a Building in Tulsa by the University of Tulsa, USA



A mould study conducted in an office building in Tulsa by the University of Tulsa using Steril-Aire UVC emitters showed a **2-log or 99% reduction in micro-organisms** dispersed from the air-handling units into the occupied space after the installation of Steril-Aire UVC emitters. There was also a **2-log or 99% reduction in fungal count** on the **duct insulation surfaces** after UVC emitters were installed.

A7. New South Wales Hospital Operating Theatre IAQ Case Study, Australia

Prior to the introduction of Steril-Aire UVC emitters into the operating theatres, significant amount of mould and bacteria were detected at various parts of the operating theatres and cooling coils, drain pans, pre-HEPA, post-HEPA , supply air ducts, supply air diffusers and operating tables. After the installation of Steril-Aire UVC emitters, **nearly all the micro-organisms were eliminated**.

B. <u>Proven and Documented Energy Savings</u>

B1. Parliament House Energy Case Study, Singapore

The Singapore Parliament House applied for Green Mark accreditation in 2009. As part of the Green Mark requirements, a chiller plant audit was conducted. The audited chiller plant efficiency of 1.1 kW/ton for the 12-year old chiller plant could not meet the minimum Green Mark requirement of 0.9 kW/ton. Steril-Aire UVC emitters installed at the AHUs completely eliminated the biofilms at the AHU coils and improved the cooling coil thermal conductance. This allowed the chiller plant to operate with higher supply chilled water temperature and the BMS (Building Management System) to 'stretch' the chiller to higher loading. As a result of Steril-Aire's intervention, the chiller plant operated more efficiently. **The chiller plant improved its efficiency by 21% from 1.1 kW/ton to 0.86 kW/ton,** allowing Parliament House to secure the Green Mark Gold award.

B2. NUS (National University of Singapore) UVC Research Study, Singapore

NUS started a research project in 2014 to investigate the effectiveness of an ultraviolet germicidal irradiation system in enhancing cooling coil energy performance in a hot and humid climate. A tender was called for the procurement of the UVC emitters. **Steril-Aire UVC emitters were selected for the research project as they met the stringent tender specifications**. In August 2016, the research findings were published in an international journal, **Energy and Buildings,** under the title: ***"Effectiveness of an ultraviolet germicidal irradiation system in enhancing cooling coil energy performance in a hot and humid climate".*** The research findings indicated that the **coil overall thermal conductance increased by 10%** and the **pressure drop decreased by 13%**, with the improvement being most rapid over the first month after UVGI intervention. **Fan energy use fell by 9% over the ten months of UVGI operation**. Savings in fan energy were 39% greater than the energy used by the UV lamps.

B3. SCADA (Southern California Air-Conditioning Distributors), USA

Skilled investigators independently tested microbial samples and airflow on a constant volume DX system before and after a Steril-Aire UVC installation at the SCADA administrative facility. They achieved improved total system performance with a **30% increase in total system cooling capacity** as well as **energy and operational savings** and **improved indoor air quality**.

B4. Rio Grande Regional Hospital Energy Case Study, USA

Before the installation of Steril-Aire UVC emitters, the **four 465-ton chillers** serving the hospital were running at **99% capacity**. After the installation of the Steril-Aire UVC emitters, the hospital is now able to keep the hospital cool with just **two chillers running** at **80% capacity**, achieving a **US$500,000 annual savings in energy costs** while **reducing maintenance and chemical costs**.

C. Optimizing IAQ & Energy Performance

C1. Auckland Internal Airport, New Zealand

Steril-Aire UVC helps Auckland Airport meet its energy consumption and carbon emission goals while improving the indoor air quality for passengers, airport employees and tenants. Microbial testing confirmed a **99% reduction in mould and bacterial colonies forming units** 31 days after installing Steril-Aire UVC emitters. Auckland Airport saves **US$272,000 in energy per year**. The resultant **15% reduction in carbon emission exceeded their planned target of 5%** and was **achieved two years ahead of schedule** due to the remarkable performance of Steril-Aire UVC. The energy savings were verified by Ivan A Fraser, Consulting Engineer for Auckland Airport.

C2. RPA (Royal Prince Alfred) Hospital, Australia

An extensive IAQ and energy study was conducted at the RPA Hospital at Operating Theatre 1 & 2 (served by AHU – 4) in 2011. Data were gathered before and after the installation of Steril-Aire UVC emitters to ascertain how the UVC emitters could eliminate cooling coil fouling, improve coil thermal conductance and air flow and enhance the OT IAQ. The results indicated the UVC emitters had **restored 58% of the cooling capacity** of the AHU. **Air flow** increased by **10.5%**. **Cooling coil pressure drop** decreased by **19%**. **Cooling coil heat transfer efficiency** increased by **65%**. **Carbon emission** reduced by **20.8 tons** in the first year and by **36.8 tons** in the subsequent years. Air sampling tests conducted in the OTs showed a drastic improvement in microbial count in the supply air at the diffusers, air at the operating tables and surfaces at various parts of the air-conditioning system.

D. Keeping Spiralling Energy and Maintenance Costs Under Control

D1. AEP (American Electric Power) Energy Case Study, USA

AEP and their subsidiary company PSO initially installed Steril-Aire UVC emitters to eliminate employee IAQ complaints. Thanks to the UVC emitters, they have also **eliminated the costly four-times-a-year coil, drain pan and plenum cleaning programmes**. In the Dallas building, they have achieved a total **15.2% or US$139,000 annual energy savings**. This energy saving translates to **28% of air-conditioning energy savings**. **Two chillers** are now running instead of the previous four chillers due to the effectiveness of the UVC emitters in optimizing the cooling coil heat transfer efficiency.

D2. Florida Hospital, USA

Steril-Aire UVC brings energy efficiency and operational savings to this Florida hospital, saving the facility a minimum of **15% in air-conditioning energy costs**, reducing HVAC downtime, and eliminating costly and labour-intensive coil cleaning work.

E. Water Recycling and Recovery

E1. University of Delaware, USA

This biotech facility installed Steril-Aire UVC emitters to improve indoor air quality and protect sensitive research and laboratory testing. The Steril-Aire UVC solution helped them achieve the added benefit of **water conservation** by **pumping the clean condensate to the cooling towers as make-up water** with an additional direct savings of **US$4,000-US$6,000 annually**.

E2. Seagate W3 Manufacturing Plant and Tan Tock Seng Hospital, Singapore

Recovery of the **clean condensate water** produced by **UVC-irradiated AHUs and FCUs** at these two Singapore facilities as **make-up water** for the **cooling towers** has been carried out. Water quality test conducted by a third-party laboratory (Analytical Laboratories (Singapore) Pte Ltd) has confirmed that the water quality far exceeds the PUB requirements for grey water to be used as make-up water for cooling towers in Singapore. The PUB requirement for standard plate count (bacteria count) is **500 CFU/ml.** Condensate produced by AHU irradiated with Steril-Aire UVC emitters was tested to have only **10 CFU/ml** for standard plate count, at only **2% of the PUB limit**. In **water-precious Singapore**, this **water recovery attribute** of Steril-Aire UVC emitters can be an **important element** in **sustainable building design**.

Based on Seagate W3's round-the-clock operation, the amount of **free, clean condensate water** produced in the plant for use by the cooling towers is approximately **18,000,000 litres per year**.

F. Enhancing Safe Food Production

F1. Martin Farms, USA

Martin Farms, a top grower, packer and shipper of butternut squash (also known as butternut pumpkin) uses Steril-Aire UVC to **eradicate both surface and airborne bacterial contamination, doubling product shelf life**. Before arriving at this solution, Martin Farms was experiencing high mould and yeast counts, based on weekly product sampling performed by Primus Labs. Since the pressurization of the space and installation of air cleaning UVC emitters from Steril-Aire, the air quality has improved and product shelf-life has increased dramatically.

F2. Washington Potato Company, USA

The use of a customized tumbling drum from Reyco Systems equipped with Steril-Aire germicidal UVC emitters effectively **destroys bacteria**, such as **Coliform**, on potato products prior to freezing and packaging. Nicholas D. Ross, quality assurance and technical services director for the potato processing company had confirmed that the **amount of money saved was significant** because they have **eliminated many costs resulting from rejected products** and **removed the related worries** associated with **potential customer dissatisfaction**, **loss of business** or even **liability**.