HVAC-R MARKET AND REED PRODUCT KNOWLEDGE

We cannot solve our problems with the same thinking we used when we created them – Albert Einstein

The Challenge

The world requires refrigeration and air conditioning for nearly every aspect of modern life. From food production and storage, data and telecommunications, manufacturing, pharmaceuticals, mining, and environmental control.

Vapor compression refrigeration and air conditioning is a simple and effective solution that has been around for decades and offers greater than 1 to 1 energy efficiency due to heat exchange, however there are problems.

It is the largest single sector user of electricity globally and the refrigerants used are normally environmentally destructive.

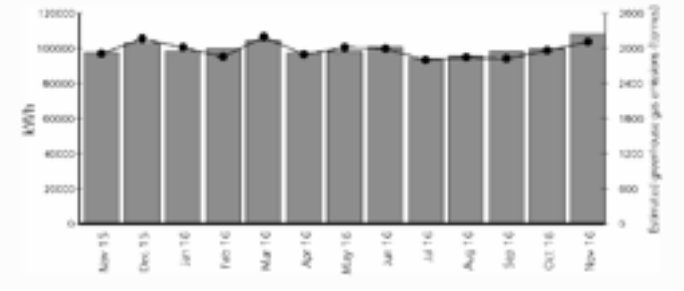
The challenge was to invent a new way of using energy which is normally wasted during operation to optimise system performance in a way that was novel to the industry.

HVAC-R is the largest single sector user of Electricity Globally
The following slides are some energy use by commercial sectors

Chiller ID	Make	Model	Maximum kWr	Max kWe
RM-1	Trane	RTUB-210	352	132
RM-2	Trane	RTHC-1C2-U0H0B3L3C2LFOQOOD	864.6	170
RM-3	Trane	RTHC-1C2-U0H0B3L3C2LFOQOOD	864.6	170
RM-4	Powerpax	A084-3C-6F	800	249
		TOTAL:	2,881.2	721

Table 10: Chiller specification

NMI Number / Gas Meter	Area / Function Supplied	Annual Consumption of Meter
NMI 4103531174	Base Building	941 MWh
DPI 52409618437	Domestic Hot Water	63 MWh



ENERGY CONSUMPTION BASELINE
The overall energy consumption of the site is summarised as follows:

Table 1.1 - Energy Baseline Reporting Period: January 2014 to December 2014

Energy Type	MWh per year	GJ per year	%	Annual Energy Cost $	GHG tCO2 per year	Cost $
Electricity	1,234.6	4,444.7	72%	$252,315	1,321.0	$204/MWh
Gas	471	1,695.5	28%	$36,913	112.1	$20.69/GJ
Total	1,705.6	6,140.2	100%	$289,228	1,433.1	NA

Table 1.2 – Energy Key Performance Indicators

Indicator	KPI electricity	KPI gas	KPI Total
Floor Area	0.96 GJ/m²/year	0.37 GJ/m²/year	1.33 GJ/m²/year
Occupied Bed Days	0.30 GJ/OBD/year	0.11 GJ/OBD/year	0.41 GJ/OBD/year

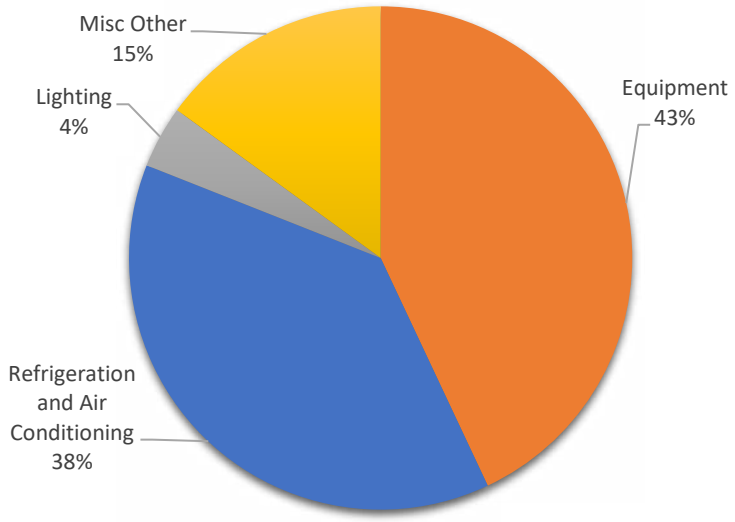
Table 9: NABERS Infrastructure Rating Results

Infrastructure Energy Rating Result	3.5 stars (3.65 stars decimal)
Total greenhouse gas emissions	17,522 kg CO_2-e/year
Predicted average daily GHG emissions for a comparable data centre performing at 3 stars	20,210 kg CO_2-e/year

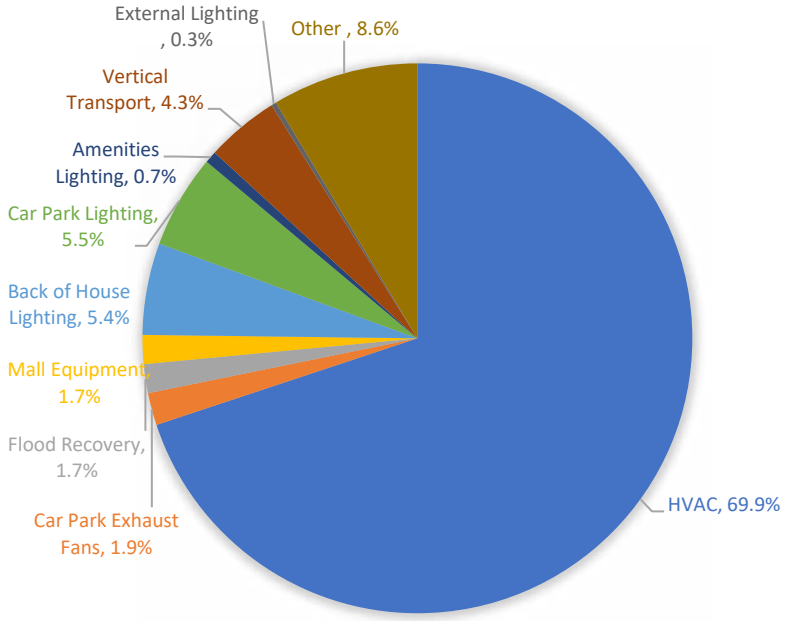
Current charges	$517,727.13
Total amount due	$1,011,613.87

Your overall picture
Estimated greenhouse gas emissions for this bill
3112.0 tonnes

FOOD & BEVERAGE MANUFACTURING



SHOPPING CENTER



HOSPITAL

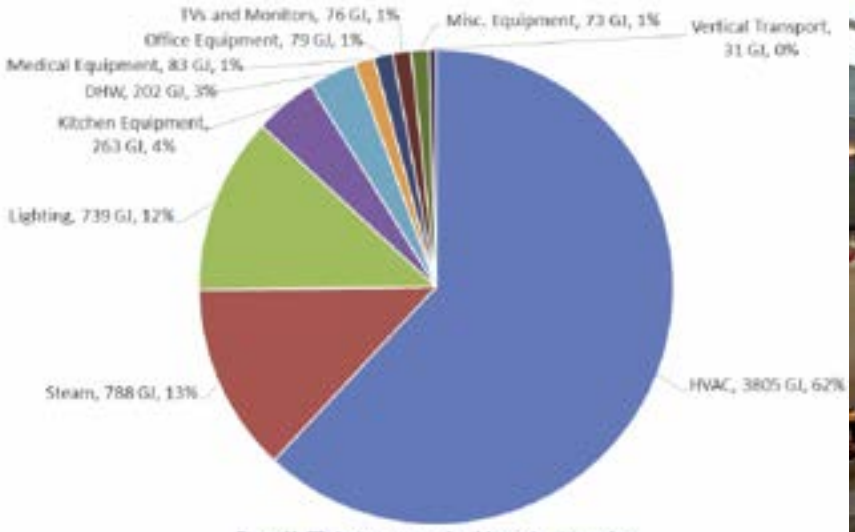
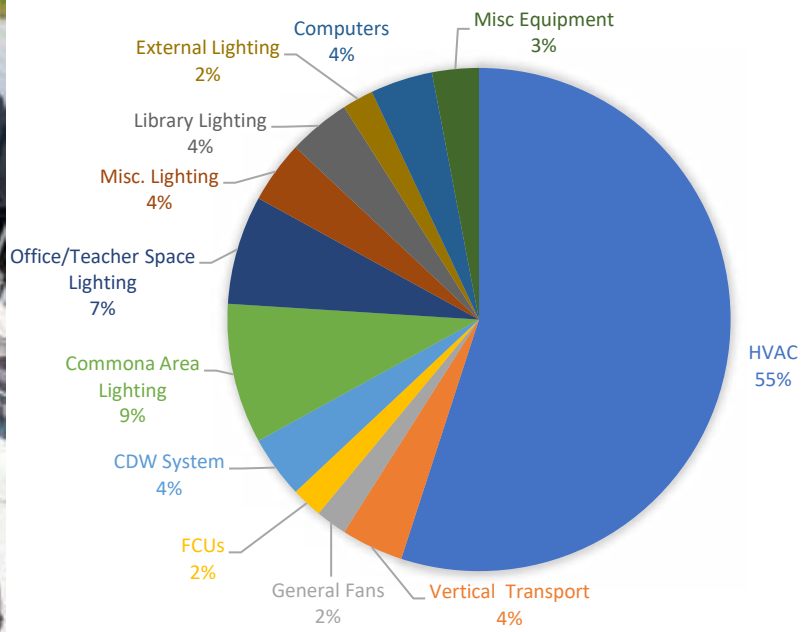
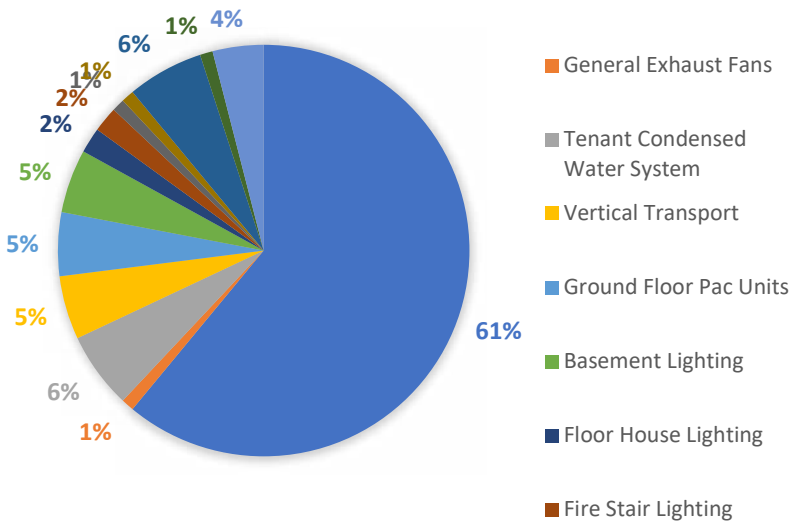


Figure 20: Whole site energy use breakdown, electricity and gas

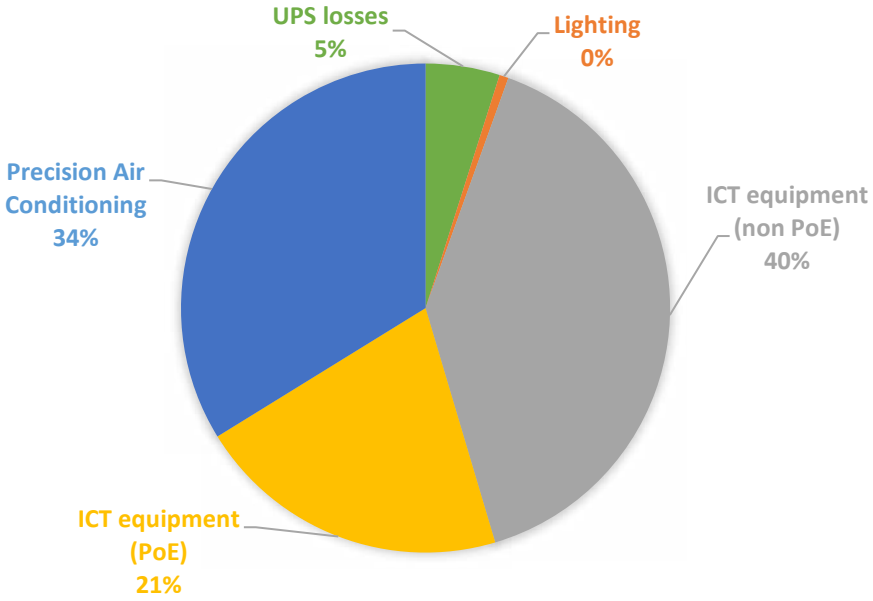
UNIVERSITY



OFFICE BUILDING

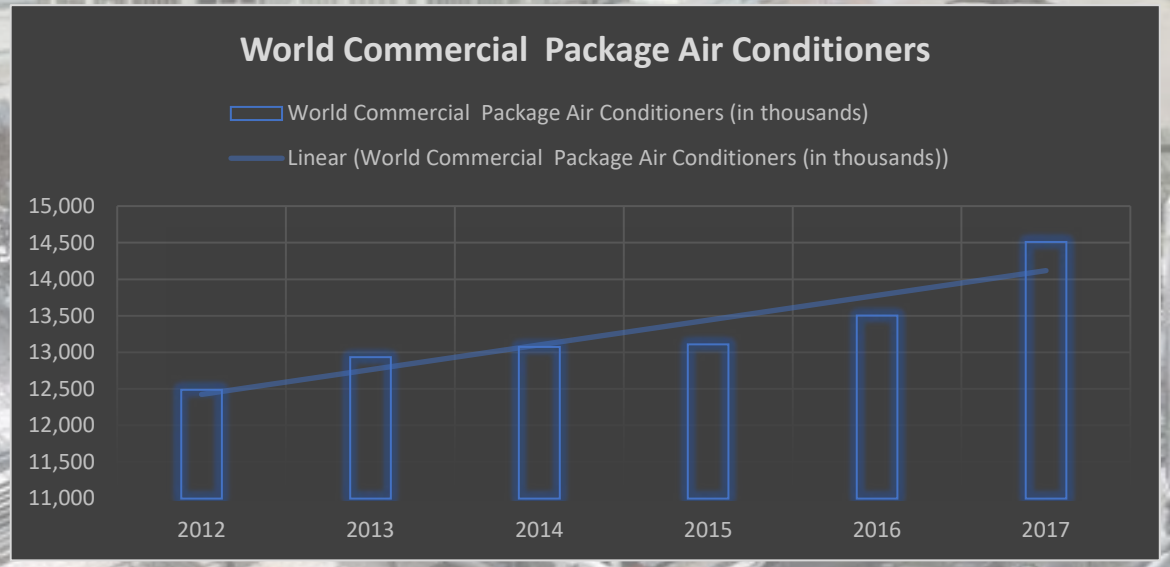


SERVER ROOM FACILITY

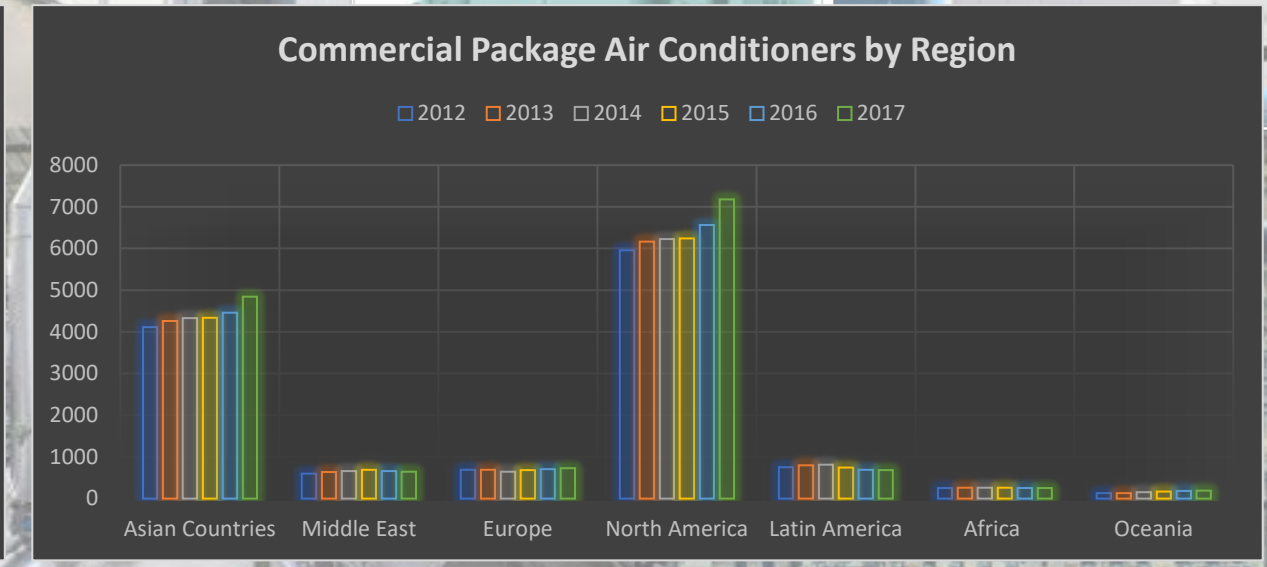


HVAC-R is the second largest Invisible industry behind Logistics *$1.68 Tn industry which is in steady growth

** Cold Hard Facts 3 prepared for the Department of the Environment and Energy – September 2018*



World Air Conditioner Demand by Region – The Japan Refrigeration and Air Conditioning Industry Association April 2018



HVAC-R System architecture hasn’t changed since the 1980’s

Current advancements within HVAC-R are optimised versions of technologies developed in the 1980’s based around compressor control and refrigerant modulation (such as variable speed drives, variable refrigerant flow [VRF], centrifugal compressors and electronic expansion devices).

REED is the first truly new innovation in decades.

REAL WORLD ENERGY SAVINGS

The Regulating Energy Efficiency Device (REED) was designed around the second law of thermodynamics, utilising normally wasted energy to improve system efficiency. REED harvests and stores refrigerant energy which is lost through normal system operation. REED then uses this ENERGY like a battery to reduce system energy requirements, saving electricity and reducing system wear, which extends plant life.

REED is a sub system which for the first time opens the refrigerant circuit to allow for dynamic refrigerant optimisation and is also able to store refrigerant as energy (high-pressure liquid refrigerant). REED adjusts the amount of refrigerant charge in the system to perfectly match the load and environmental requirements, whilst storing any removed refrigerant as high-pressure liquid energy, meaning that when it is returned to the system the compressor does not have to recreate this work (energy).

A sustainable technology which can significantly reduce emissions.

The REED Light Bulb Moment

The REED Technology can generate energy savings of up to **27.6%** and work on systems from 60kW to 2 Mega Watts.

All while only using the electrical power of one incandescent light bulb.

Retrofit Design

The REED™ system is easily retrofittable to any existing or newly installed HVAC-R system and generates instant benefits with reduced electrical costs and minimises the systems environmental impact.

With only 2 pipe connections to the resident system and a 110-240v power connection, the system can be installed extremely quickly with minimal downtime to the existing infrastructure.

Service accessibility to the system has been ergonomically designed so that components can be extracted from the REED™ cabinet with minimal obstruction. A ‘master’ REED™ cabinet can be easily connected to control ‘slave’ units using only one pipe connection and one data connection to facilitate larger systems.

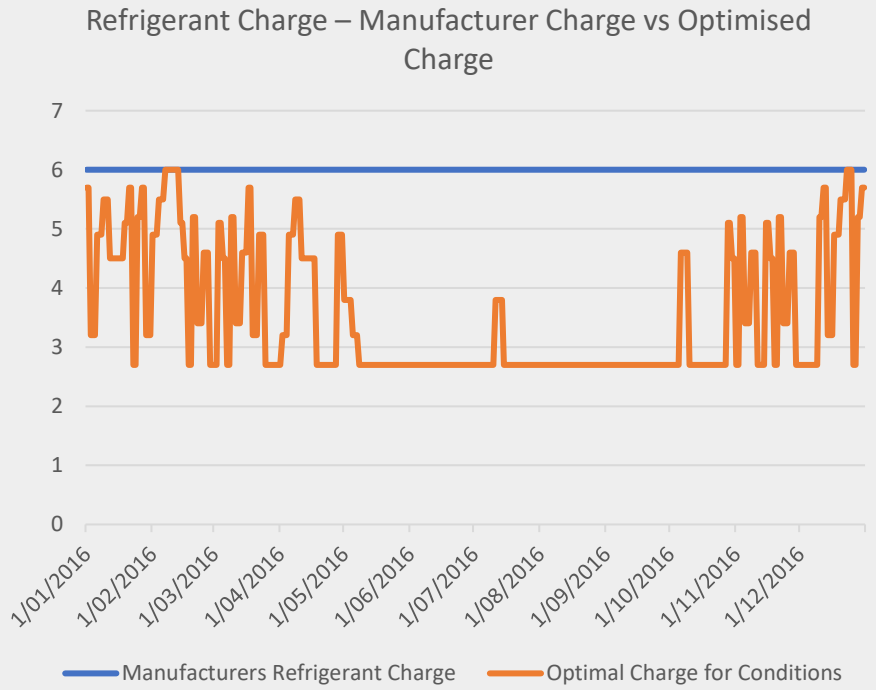
Dynamic Charge Optimisation™

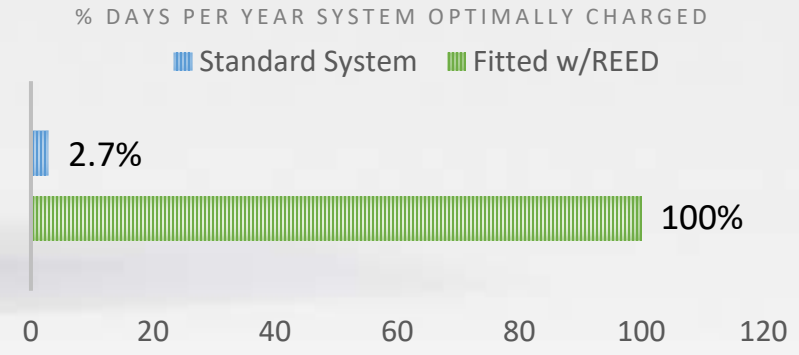
Refrigeration and air conditioning systems are specifically designed to meet minimum performance standards (MEPS) and severe environmental conditions (e.g., AS/NZS 3823.1.2:2012 T1) outlined by government authorities and standards agencies by the manufacturer.

These systems are then oversized for the installation to guarantee performance in any conditions.

This equates to these systems being optimally charged for approximately 7-10 days of the year with every other day a necessary compromise in efficiency due to a sealed refrigerant circuit.

REED continually moves refrigerant energy in and out of the system to suit the changing climatic conditions and system loads allowing for correct charge optimisation 100% of the time and the ability to store normally wasted energy as work for the system, extending system life.





REED Boost

If you drive a car, you will know that a lot of energy is produced by accelerating or breaking the vehicle over the course of a journey.

We know that this energy is lost unless it can be captured within a battery for use later as in a hybrid car.

REED boost control and algorithm works to detect excess energy within the system and harvests and stores refrigerant energy which is lost through normal system operation.

This computer-controlled sequence supplements the peaks and troughs of energy usage, working like a high-pressure refrigerant battery to save you energy.

If the system is a constant speed system (stop/start systems), which make up the majority of installed commercial equipment, REED will prior to the compressor cycling off store a portion of the high-pressure liquid refrigerant as energy. Then when the system cycles off and the remainder of the refrigerant loses it energy through heat exchange and becomes one mixed pressure which the compressor must then overcome on start up.

REED acts as a booster by reintroducing the stored high-pressure refrigerant as work to allow the system to achieve steady state faster, minimising the compressors electrical requirements.

WORKS WITH EXISTING TECHNOLOGIES

REED is a revolutionary stand-alone energy saving device however, as it saves energy in a completely unique way, it can be installed in conjunction with existing energy saving technologies to compound energy savings. REED through optimisation and energy storage can also balance out inefficiencies from other energy saving technologies. Further increasing their effectiveness.

Machine Learning Control Software

REED works on technology that to uses machine learning to get the very best insights into HVAC performance and applying this data to improve system performance.

Notice the next time you use an online streaming service, you will see that the menu selections prompt you for your best viewing choices. This is a basic form of machine learning, the service knows what has worked in the past and recommends based on that.

In a similar way, REED monitors the background temperatures, pressures and environmental conditions, the software can adjust the system refrigerant levels instantaneously given the ideal conditions in the past. This optimisation is achieved by “training” the software on systems that run under various scenarios and choosing the best settings.

REED therefore understands what is going inside the system in real time, and can adjust its performance continually, these tiny adjustments add up over the course of a day, month, and year to save you real money on your HVAC power bills.

Predictive Maintenance & Serviceability

REED’s on-board Machine Learning will continually diagnose, predict and display possible faults allowing for pro active not reactive maintenance with programmed down time.

This combined with REED’s monitoring alarm systems allows technicians to diagnose the system fault before sending technicians to rectify them.

REED’s onboard refrigerant gauges offer service technicians the ability to remote into the system and see pressures and temperatures in all four stages of the vapor compression cycle along with super heat, sub cooling, power usage, temperature and humidity or flow meters (chillers) and system capacity in real time.

This feature means that mechanics do not have to attach refrigerant gauges which results in line losses of refrigerant contributing to system inefficiencies and climate change.

The Challenge

Every established HVAC-R system of any age will, over time experience refrigerant leakage.

Most of the time this is hidden and accumulates in the form of decreased system performance and higher energy usage.

1 kilogram of refrigerant can be equivalent to 2 tones of CO2 or more

**Calculate the carbon dioxide equivalent quantity of an F gas. www.gov.uk*

The average system leak rate is 6.5% per annum. ** Cold Hard Facts 3 September 2018*

Estimated Refrigerant Leaks per annum in Australia (3% of global market) are more than ***2955 tones** which is like running **over 1.3 million cars for a year**. ** Cold Hard Facts 3 September 2018 – Greenhouse Gas Emissions from a typical Passenger Vehicle –US EPA*

The challenge was to invent a new way of detecting and mitigating these leaks in a way that was novel to the industry.

Leak Detection and Mitigation

As REED is fluidly connected to the system and constantly adjusting the refrigerant charge, it is also able to detect with incredible accuracy and precision the refrigerant charge level of the system and therefore it can detect system leaks and micro leaks with an averaged accuracy over a 24-hour period of 0.01137%, which far exceeds any other leak detection solution.

During REED's development we discovered that micro leaks generally occur within specific pressure ranges.

REED can detect the pressure at which these leaks are occurring and then temporarily, by adjusting the system pressure through refrigerant manipulation, mitigate these leaks while alerting the stakeholders that service is to be undertaken, virtually eliminating refrigerant venting to the atmosphere and the significant issues associated with these high global warming potential (GWP) F gases making their way into our atmosphere.

The Challenge

Stakeholders of HVAC-R equipment are continually trying to improve design and performance of their plant & equipment as this is a direct cost of business with any improvement directly effecting their bottom line.

This is also true in the maintenance of the plant with significant cost savings in being proactive not reactive to avoid, where possible costly failures.

The other common challenge in designing and running these systems is common data sets that allow for direct comparison of the equipment based on environmental conditions, geographical locations and by make and models of specific systems.

The challenge was to deliver innovative software and targeted concise data to the industry.

Software as a Service

Monitoring & Alarms

Refrigeration and Air Conditioning trouble frequently happens when no one is looking.

REED monitoring knows exactly what's happening with your HVAC-R system. Follow temperature, refrigerant pressures, cycle times, cycle frequency and power consumption, sub cool super heat and more. View real-time data as well as historical trends. Gain the power, insight and peace of mind that REED monitoring delivers.

REED is designed to be your on-site refrigeration expert so you don't have to be and offers our customers online 24/7 system monitoring that can detect systems faults and alert stakeholders.

REED data sets are collected and displayed using a common format, this allows for direct comparison for stakeholders across all their sites.

Software Updates

As REED is a novel new technology it is continually evolving as we learn further capabilities. By subscribing our customers will receive updates to any software that was purchased with the REED hardware. This includes any software updates and patches.

New Software Products

REED is being continually researched and developed to generate new functionality to offer further savings, better system or refrigerant management or to meet new regulatory mandates and requirements.

These new products will be offered to our existing clients through subscription to increase the value proposition of their REED products.

Third Party Features

Along with the REED system owner, other stakeholders can take advantage of REED functionality through our subscription service.

Service Technicians can subscribe to access system diagnostics remotely to allow for a targeted more cost-effective response to fault detection.

Stake holders looking for data to assist them in designing systems for purpose, climate, geographical location can subscribe.

Government Agency looking for Data Sets to help with planning, policy making, and regulatory compliance can also subscribe for the data.

Data Sets

REED uses a rich set of data gathered by the system sensors, we can measure the dynamics of a HVAC system in real time and get the best performance out of the system, for the conditions.

Over time, machine learning technology can be used to capture even more information about the site the equipment is running on.

As the number of installed sites grow, machine learning methods can incorporate data from multiple regions, climates, equipment types and conditions to get superior performance for an HVAC site based on a vast amount of data points.

This information can also be used to predict failure points in systems, based on data collected and catalogued from breakdowns on existing sites.

The software can predict a probability of failure based on conditions it detects in the system, trained from experience of other sites in the past.

This allows managers to get early warning of potential equipment failures, schedule preventative maintenance and avoid costly trading period downtime and equipment replacements.

We believe this is a huge step forward in providing business owners, consultants a high level of valuable real time data on the performance of one of their biggest costs basses.

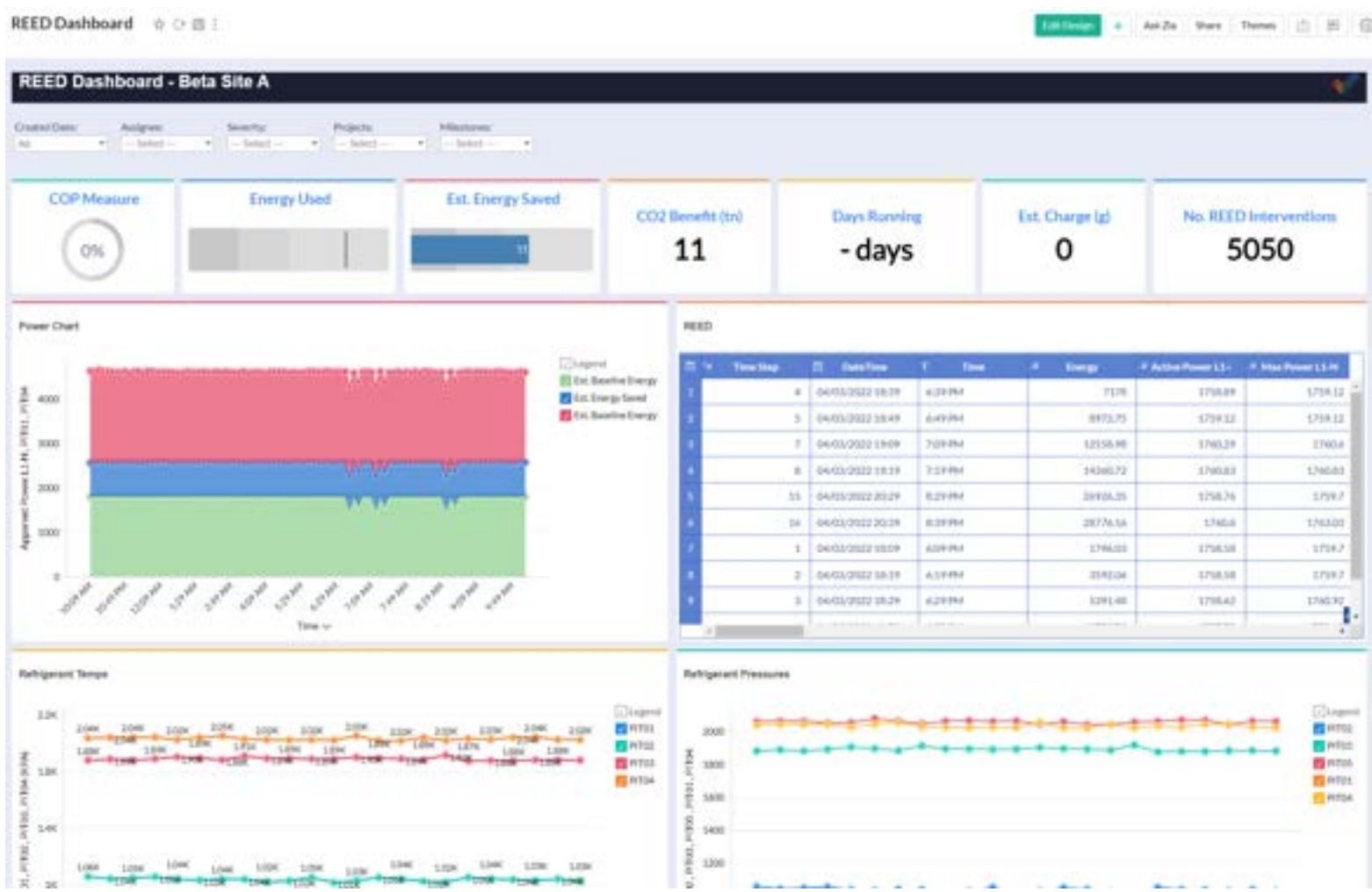
As we enter an era of increasing climate regulation and rising energy costs, quality data, energy saving and predictive software models will give REED's customers the competitive advantage.

Advanced Cloud Based Dashboard

REED's Advanced Cloud Based Analytics transforms the way HVAC-R Stake Holders measure and analyze their plants effectiveness.

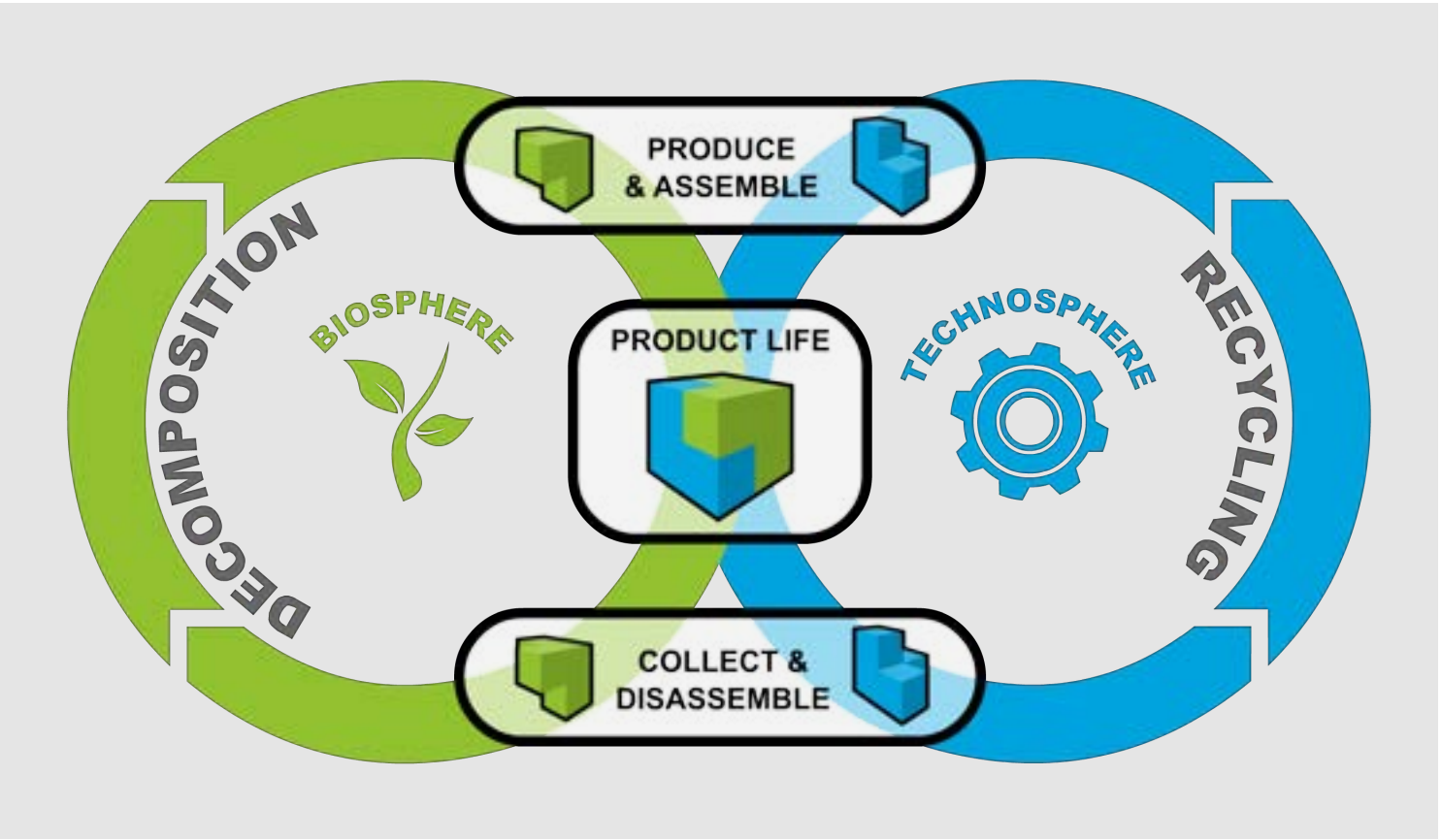
Our Dashboard gives an overview of the key performance indicators of the customers system. Designed to be easy to understand in order to keep executive management informed on the day-to-day energy and environmental savings generated by REED.

The Dashboard is also used to access system summary reports and maintenance alarms for corrective action.



Multi Circuit Control

Each REED system can control up to two (2) refrigeration circuits in multi circuit systems meaning for smaller twin circuit systems you will only require on REED unit; this can assist with an accelerated return on investment.



Cradle to Cradle Design

A cradle-to-cradle design philosophy was employed on the REED product with most components able to be infinitely recycled.

This philosophy promotes that raw materials are not wasted but retained within the biological or technological cycle. Waste is a nutrient, either for the biosphere, or for the Technosphere. It is therefore important to reuse these raw materials, either as fully compostable biological material, or as high-end technological resources. Every product is part of a perpetual cycle, in which it is reused and preserves or increases its value. Upcycling instead of downcycling. Now the cycle goes from cradle to cradle.

ISO 9001 - Certified

REED TRADING PTY LTD

Quality Policy and Objectives

REED Trading Pty Ltd strives to contribute as a responsible corporate citizen by developing innovative products and solutions that reduces energy consumption and minimise GHG emissions for the HVAC&R industry.
Our aim is to interpret our customers' needs and to source and supply products which best suit those needs in terms of quality of products as well as quality of service. We recognise our responsibility to supply products that complies with relevant Australian Standards and market requirements.
We are committed to serving our customers with a consistency of quality that can be relied upon and we see this being attained by:

- Maintaining a Quality Management System complying with AS/NZ ISO 9001.
- Identifying business risks with respects to markets we are operating
- Understanding the needs and expectations of stakeholders including our customers
- Establishing business plans and performance objectives
- Providing Staff training to improve skills, methods and product awareness to achieve consistent and shared quality values.

Quality management involves every single employee as well as top management at REED Trading Pty Ltd and requires their full support in implementation, operation and continual improvement of the effectiveness of this system.
Our objective is to continually improve the effectiveness of our business processes by adopting a Quality Management System including measurable quality objectives and to be responsive to customer needs to ensure enhanced customer satisfaction.
Our quality objectives are:

- Improve Customer satisfaction
- Improve Quotation Conversion Rate
- On-time delivery of products
- Reduce Rework

Quality Management · ISO 9001

Global-Mark.com.au®

Grants and Partnerships

Kick Start Program
WINNER
CSIRO Kick Start Grant

CSIRO Kick-Start is an initiative for innovative Australian start-ups and small businesses, providing funding support and access to CSIRO's research expertise and capabilities to help grow and develop their business.

Congratulations, your competitive grant application has been successful.

WINNER
NSW Government MVP Innovation Grant

Thank you for your interest in the NSW Government's MVP Grant Program. We are pleased to let you know your application has been successful!

Please allow a couple of days for our admin team to create funding agreements. You will receive an email once the funding agreement is generated, there is nothing else you need to do at this stage.

Congratulations!

Clean Energy Finance Corp

The Innovation Fund draws on CEFC finance and expertise to invest in innovative businesses whose activities can lower Australia's emissions. Innovation Fund portfolio companies are pursuing diverse opportunities ranging from mobility and smart cities to agriculture, the circular economy and innovative energy demand management solutions.
The Innovation Fund invests in companies with experienced and capable management teams, a competitive edge in technology and innovation, and the potential for both domestic and global market application of their technologies. It works to match these companies with cleantech investors, who are motivated by the positive environmental impact of cleantech innovation, as well as commercial potential and robust business fundamentals.

Awards

Engineering

The Good Design Awards Jury commented: *“An exciting innovation with enormous potential benefit. The design is clearly well thought through (cradle-to-cradle, retrofittable, safety, impact of system failure etc). The validation from other entities including CSIRO and CEFC also vouches for its potential value. The physical design is highly appealing and appropriate for the type of installations where it will be applied. This is a significant advancement with wide applications that could have a major positive environmental impact. The ability to retrofit to existing facilities is a strong feature of this equipment. This is really impressive work and a standout example of good design in this category that deserves to be recognised. Well done. ”*

Product Design - Commercial and Industrial

The Good Design Awards Jury commented: *“A clean design, easily retrofittable, this innovation is to be commended. The level of thinking that has gone into developing a way to approach energy savings and leak mitigation, is impressive. This has been translated into a clever product, with a no-frills aesthetic, underpinned by intelligent consideration for cradle-to-cradle recyclability. Well done.”*

			201717045718 India
			Pending
US10,401,063 B2 United States	AU2016297673A1 Australia	CA2989952A1 Canada	KR20180030988A South Korea
Application Granted 03-09-2019	Application Granted	Pending	Pending
CN108027182A China	EP3325899A4 Europe	BR112018000516A2 Brazil	P6000117/2018 United Arab Emirates
Application Granted 15-09-2019	Application Granted	Pending	Pending
JP6925333B2 Japan	738331 New Zealand	MX2018000655A Mexico	PI 2017001884 Malaysia
Application Granted 25-08-2021	Pending	Pending	Pending

Independent Validation

Although Cresstec operates the Cresstec HVAC-R Research & Development Test Facility (CHRDTF) which is currently engaged by the Department of Agriculture Water and Environment to supply data sets and reports.

Cresstec works with both the CSIRO National HVAC Performance Testing Facility (NHPTF) and external engineers to independently validate the REED technology.