



iviva C₂O
C₂O (Commissioning to Operate)



The Problem

Climate change, an aging population, pandemics and the move to hybrid working are converging to dramatically raise the sustainability and productivity goals of building owners, operators and tenants.

This requires step change improvements in the way buildings and workspaces are operated and maintained.

Despite the increasing adoption of smart technology, most buildings are still operated in the same way for the last 50 years:

- Manual and inefficient performance management of building systems.
- Reactive and scheduled building maintenance
- Reliance on “raw” alarms, that do not identify the root cause.
- Lack of a ‘single pane of glass to view exceptions and performance.
- Reliance on spreadsheets to compare performance across properties.

This leads to a piecemeal approach to operations and maintenance, which limits productivity and keeps performance low and costs high.



The Solution

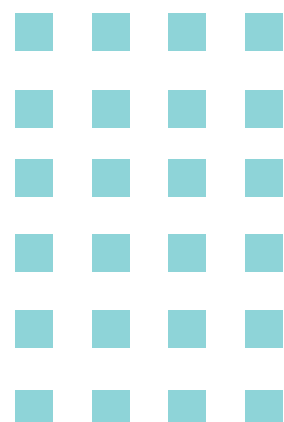
iviva.C₂O provides a paradigm shift in the way buildings and workspaces are operated and maintained. By combining process automation, advanced analytics and AI, it enables autonomous and predictive operations and maintenance, bringing enormous improvements in equipment and system performance, work productivity and occupant satisfaction.

Equally, iviva.C₂O is easy to implement. You can “compose” a solution for the most complex buildings by assembling prebuilt models and visualizations from an extensive library, just like assembling a Lego set.

This is a very important capability because every building is different and requires a custom solution. With iviva. C₂O, creating custom Smart Building solutions is easy.

With iviva.C₂O, not only do you get all this for a low cost, but you can also start saving as much as 30-40% from your operations and maintenance costs from day one through improved productivity and reduced energy consumption.

And your occupants will be happier too!



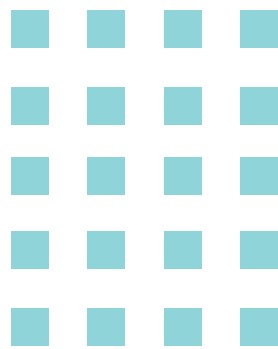


Our field-proven approach enables:

- Integrated primary and continuous commissioning - ensuring an operationally ready Smart Building from the time of hand over, minimising rework and reactive maintenance.
- Self managed infrastructure - automate building performance management; reduce manpower demands and increase system reliability & resilience.
- Composable Digital Twins - pick from a library of pre-built digital models and AI/ML powered algorithms; 'compose' your own Digital Twin to suit your assets and spaces, saving time and cost on complex Digital Twin implementations.
- Predictive Maintenance and Automated Fault Detection & Diagnosis (AFDD) - AI/ML powered sentinels monitoring systems 24x7, predicting what could go wrong and detecting underlying problems before they surface; helps achieve step change improvements in productivity, and system reliability and performance.



iviva.C₂O expedites the delivery of operational Physical & Digital Twins.



iviva.C₂O helps building owners/ operators to reduce manpower by >30-40% and achieve savings of 15-20% on energy, among other benefits.



C₂O Capabilities



i) Predictive Operations

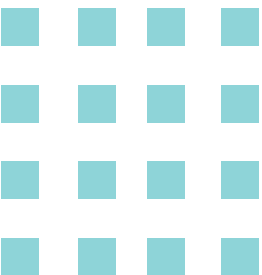
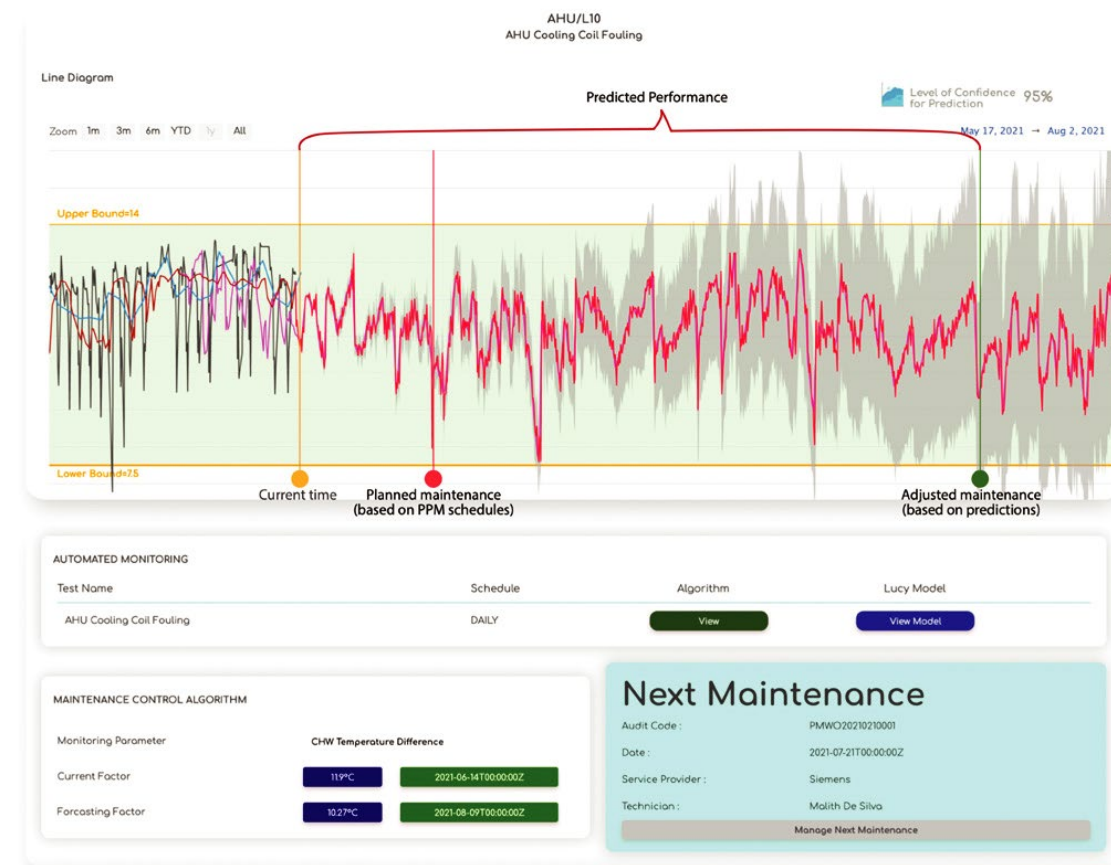
1. PREDICTIVE OPERATIONAL ANALYSIS

Predictive Operational Analysis Predicts future performance of equipment and systems and identifies anomalies and notifies technical staff to carry out adjustments to prevailing planned preventive maintenance (PPM) plans.

BENEFITS:

- Accurately forecast future performance and failure of equipment and systems
- Detect failures before they occur, increasing uptime and reducing Corrective Work
- Save on manpower and money

PREDICTIVE OPERATIONS AND MAINTENANCE HAVE PROVEN TO DETECT FAILURE BEFORE IT OCCURS. INCREASING UPTIME AND REDUCING CORRECTIVE WORK MANPOWER COST BY OVER 25%



ii) Automated Early Fault Detection and Diagnostics (AEFDD)




Automated Fault Detection and Diagnostics (AFDD) and automated Root Cause Analysis (RCA) engine proactively detects equipment faults before they surface and directs maintenance work, along with recommended remediation actions.

BENEFITS:

- Helps to maintain optimum infrastructure well balanced in Comfort and Energy consumption.
- Reduces occupant complaints
- Speeds up rectification by automatically including remedial actions in work orders

AFDD increases system reliability, reduces complaint management time by 50%, reduces Corrective Work Order volume by 50%, and saves energy by up to 20%.

FAULT DETECTION AND IMPACT ASSESSMENT This Year | DCC



HVAC

Asset Name

Equipment	Serving Locations	Fault Detected	Cost Of Failure (USD)	Risk Impact Value	Resolution Process	CWO
FAHU-L0-R.EAST-C... <small>2022-01-29 01:29:24</small>	DCC.GFEWEast Walkway	Supply fan VFD feedback value (1.86 %) is not around the VFD...	463.41	72	Closed	
FAHU-L1-FOOD COU... <small>2022-01-12 01:30:47</small>	DCC.IFEWVanellis, DCC.IFEWSUBWAY...	AHU is not commanded to shut down according to the...	404.5	320	InProgress	
FAHU-L0-R.EAST-C... <small>2022-01-12 01:30:40</small>	DCC.GFEWEast Walkway	Supply fan VFD feedback value (2.03 %) is not around the VF...	463.41	72	Closed	
AHU-L2-MALL RF W... <small>2022-01-11 15:04:22</small>	DCC.2FEWWC Escalator Lobby SF...	AHU is not commanded to start according to the...	404.5	64	Closed	

Total Saving: USD 1,750

VIEW RT PAGE | 2021/08/24 17:54:23 | 21.1°C | 50% | 420 ppm

ROOT CAUSE ANALYSIS

We noticed a comfort failure

Root Cause

- Chiller Plant CHW Header
 - Chiller Plant Header Supply Temperature is (8.2 °C) greater than Chiller Plant Header Supply Temperature Setpoint is (6 °C)
- Chiller 3
 - Chiller 3 CHW supply temperature is (11.6 °C) not reaching to the setpoint (6 °C)
 - Chiller 3 Evaporator Approach is (0.2 °C) not around the design value

Detected Failures

- FCU_GE_001
 - CHW Supply temperature is (11.2 °C) greater than Maximum temperature value for CHW Supply temperature (8 °C)
 - Space Temperature is (26.8 °C) has not reached to temperature setpoint (24.5 °C) after 5 minutes

Successful Execution

- FCU_GE_001
 - FCU is Auto Mode
 - FCU is Running
 - Filter Differential Pressure Maximum Value is 140 Pa
 - Filter Differential Pressure is (35.56 Pa) less than maximum pressure difference (140 Pa) Filter is not clogged
 - FCU is Auto Mode
 - FCU is Running
 - Space Temperature Setpoint is 24.5 °C
 - Space Temperature is (26.3 °C) greater than temperature setpoint (24.5 °C)
 - CHW Valve Control is (95.7%) is greater than lower limit value (80%) when space is too hot
 - CHW Valve Feedback is (94.3%) is around control value (95.7%)
 - FCU is Auto Mode
 - FCU is Running
 - Space Temperature Setpoint is 24.5 °C
 - Space Temperature is (26.3 °C) greater than temperature setpoint (24.5 °C)
 - CHW Valve Control is (95.7%) is greater than lower limit value (80%) when too hot
 - CHW Valve Feedback is (94.3%) is around control value (95.7%)

Maintenance Details (Problematic Assets)

Asset ID	CWO	Previous PPM	Next PPM	Predictive Analytics
Chiller 3	CWO202108242495 2021/08/24			

Raise a New CWO

Tasks

- Chiller Plant CHW Header
- Chiller 3
 - Check chiller 3 operational parameters for any faulty operation. Physically check and verify cooling towers, condenser water pumps and chilled water pumps are working properly
 - Inform the faulty operation of the chiller 3 to the contractor if the maintenance contract is still within the warranty period

Observation

- Chiller Plant CHW Header
 - CHW supply header temperature is greater than its setpoint
- Chiller 3
 - Chiller 3 CHW supply temperature is not reaching to the setpoint

[New CWO](#)

AHU/L10

INSIGHT

We noticed a defect

AHU CHW Valve Control

- CHW valve control value (35 %) is lower than the accepted value (80%)

VERIFICATION SUMMARY

Cycle	Time	Status
Cycle-01	2021/05/06 13:54:56	Failed
Cycle-02	2021/05/06 13:55:22	Failed
Cycle-03	2021/05/06 13:55:46	Failed
Cycle-04	2021/05/06 13:56:12	Failed

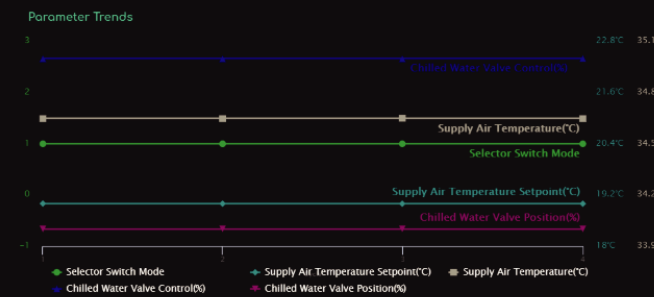
100% Failed

Recommendations

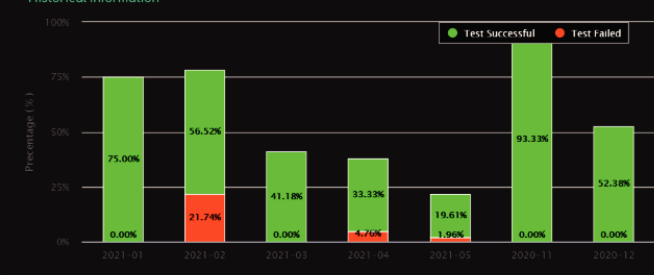
- Internally checking filter clog and supply fan speed and trip status)
- Physically cross check the CHW valve actuator
- If there any issue take necessary actions (Check the power line for correct voltage
- Check that the wiring complies with the actuator wiring diagram
- Control box is damaged
- Replace electric actuator motor

ILLUSTRATION OF ANALYTICS

Parameter Trends



Historical Information

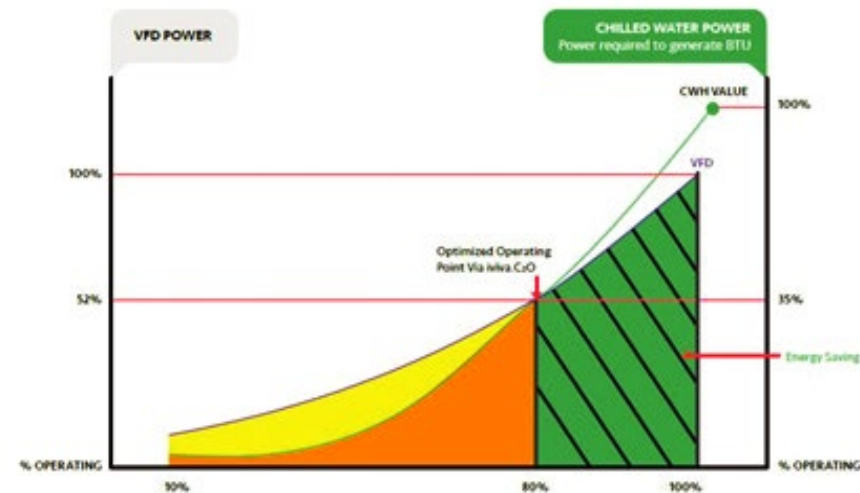


Last PPM: 2021/05/03 06:02:00
 Next PPM: 2021/08/02 06:02:00
 Last WorkOrder: CWO202105051082
[History](#)

iii) Operations Optimizations

iviva.C₂O continuously monitors changing conditions in a building, and automatically controls equipment. Granular control against Building Management System (BMS) control strategies can help reduce energy consumption by 5-10%.

Ex. occupancy and external ambient conditions while ensuring temperature, humidity and C₂O are at acceptable levels.



Supply Air Temperature Setpoint Adjustment

Under this aspect it checks whether Supply Air Temperature Set point is providing the cooling requirement and bringing the Return Air Temperature below its set point, if not, it adjusts supply Air Temperature Set point to fulfill the cooling requirement. The algorithm ensures that Supply Air Temperature is sufficient to serve the cooling requirement a lower VSD Speed. It ensures the delivery of required thermal comfort, without any energy wastage.

BENEFITS:

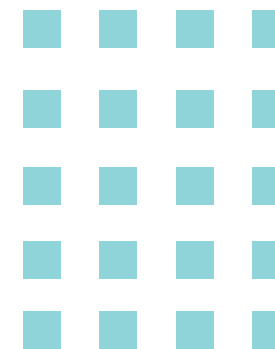
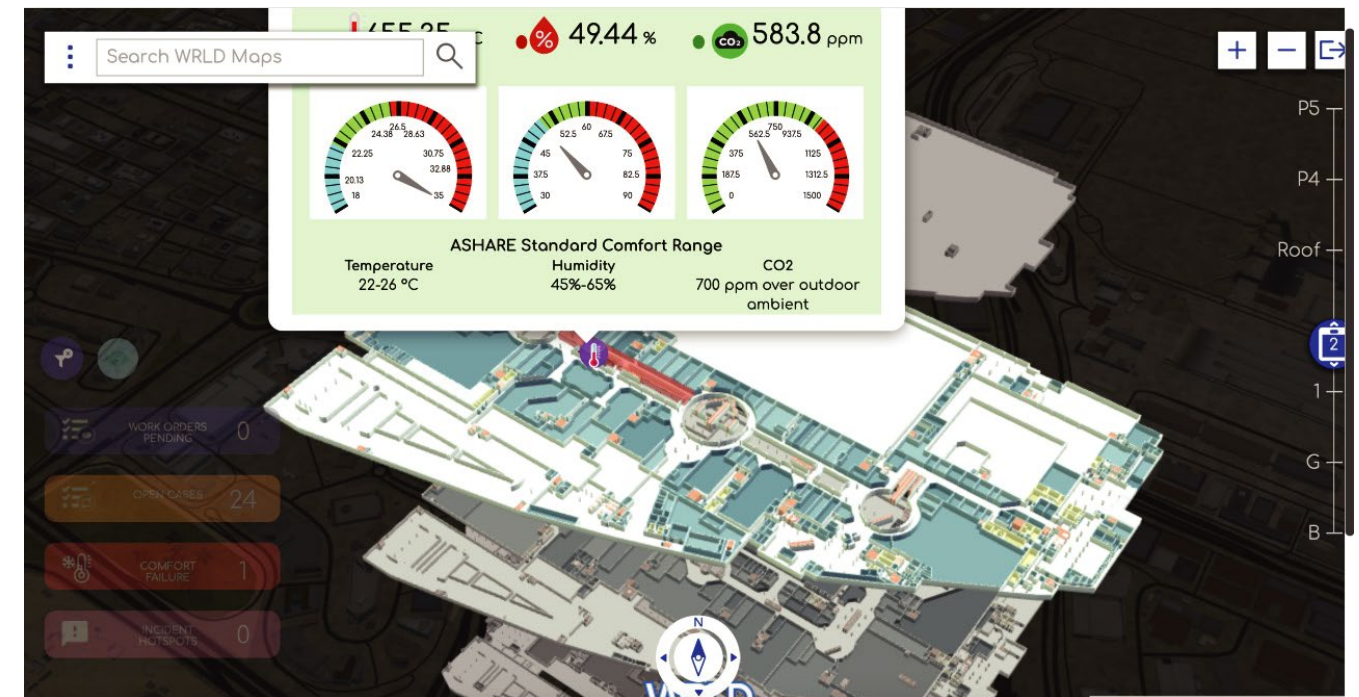
- Optimize energy consumption by automating control of equipment to suit dynamic operational conditions (E.g., Monitor occupancy, ambient conditions and auto adjust AC; auto adjust/ switch-off equipment based on dynamic occupancy patterns., Dynamic air purging based on changing ambient conditions etc.).
- Adopts a holistic approach to energy saving using cross-system monitoring and automated control, to achieve superior cost savings
- Reduces the dependency on manual adjustment of systems, decreasing manpower costs and eliminating room for human error

iv) Space Centered maintenance

iviva.C₂O enables space-centered maintenance by linking Automated Fault Detection and Diagnostics (AFDD) to the space comfort conditions (temperature, humidity, IAQ) monitoring. As such, any abnormal space condition automatically registers a fault for the segment of the HVAC (Heating, Ventilation and Air Conditioning) system that serves the space.

BENEFITS:

- Proactive management of spaces
- Improve occupants' satisfaction resulting 50% reduction in complaints

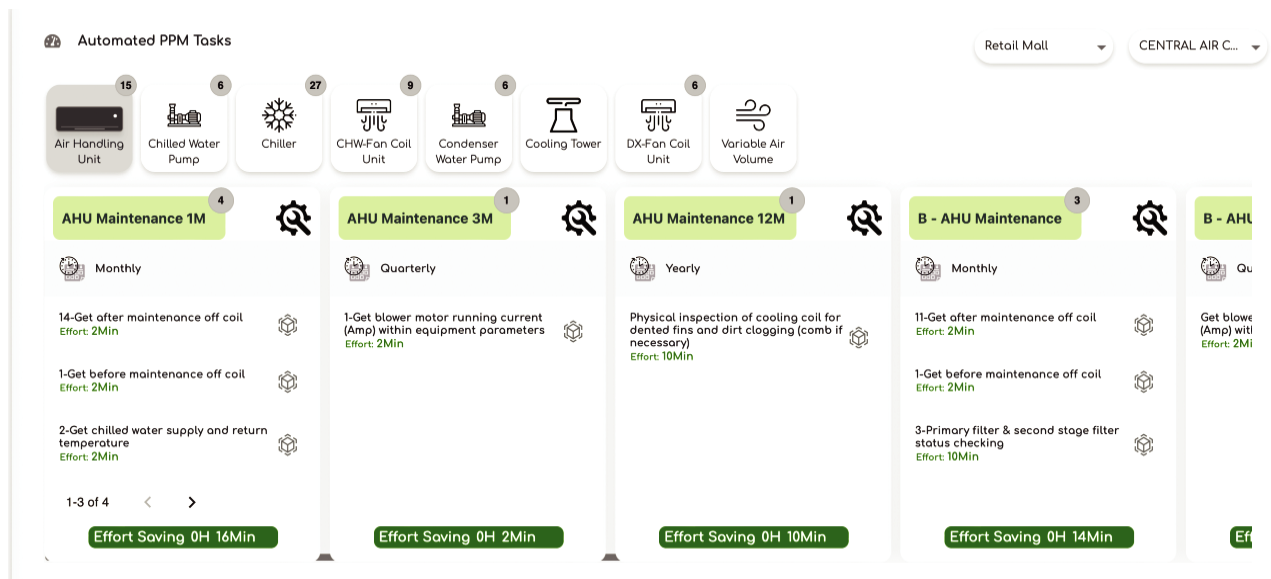


v) PPM task Automation

iviva.C₂O automates Planned & Preventive Maintenance (PPM) checks in various systems, eliminates the need for resource intensive manual checks.

BENEFITS:

- Delivers 15%-20% savings in manpower
- Eliminates room for human error

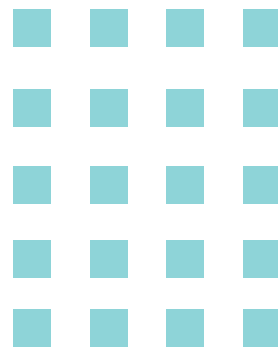


vi) AUTOMATIC WORK VERIFICATION

iviva.C₂O automates the verification of work completed by technicians, ensuring accuracy of tasks completed, and proper rectification of faults. If any discrepancies are detected, technicians are alerted and rework is assigned automatically.

BENEFITS:

- Delivers 10%-15% savings in manpower
- Improves infrastructure reliability by >90%
- Eliminates room for human error



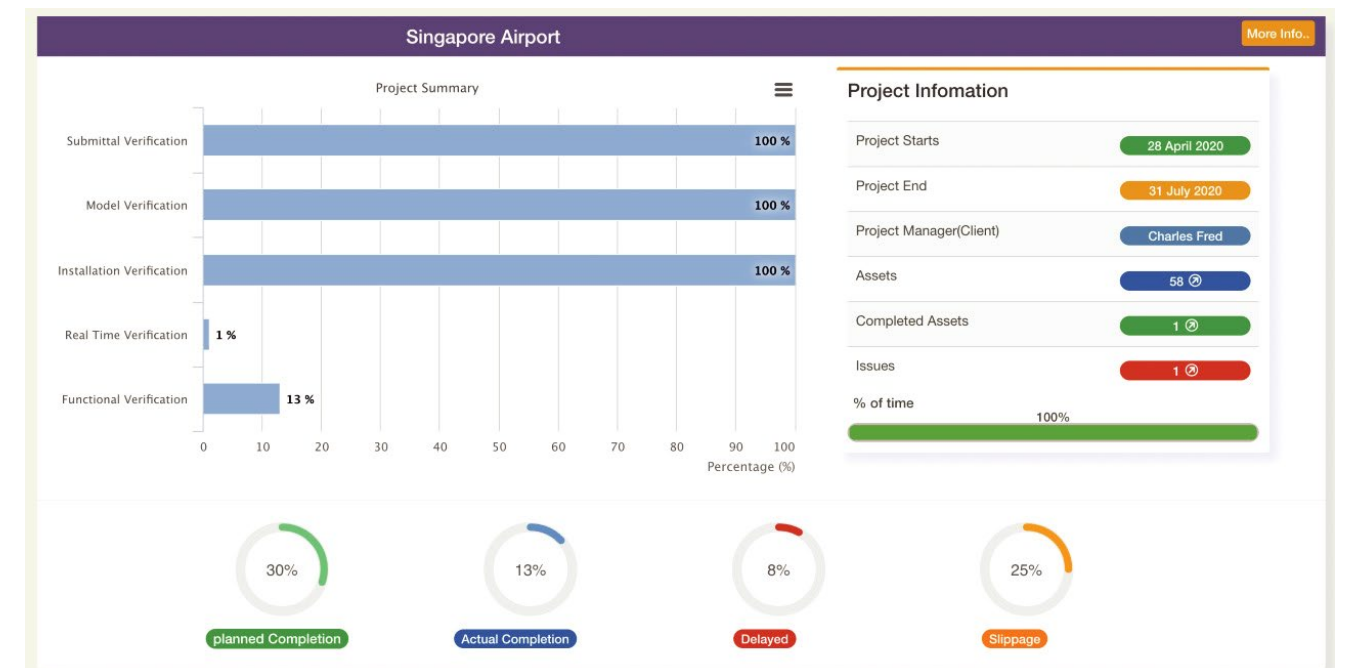
vii) IDD - Commissioning & Handing Over

iviva.C₂O enables Integrated Digital Delivery (IDD). It expedites the delivery of the Physical Twin, and ultimately delivers an operational Digital Twin.

iviva.C₂O handles both primary commissioning and continuous commissioning effectively. Without limiting to a sample of 10-15% of systems, it helps you to achieve 100% commissioning of your building

BENEFITS:

- Supports all mainstream commissioning standards such as ASHRAE, Green Building Index, NEBB (National Environmental Balancing Bureau), and Green Mark, etc...
- Decentralizes manpower-intensive tasks such as point uploading to system suppliers
- Eliminates the dangers of sample commissioning by enabling complete commissioning

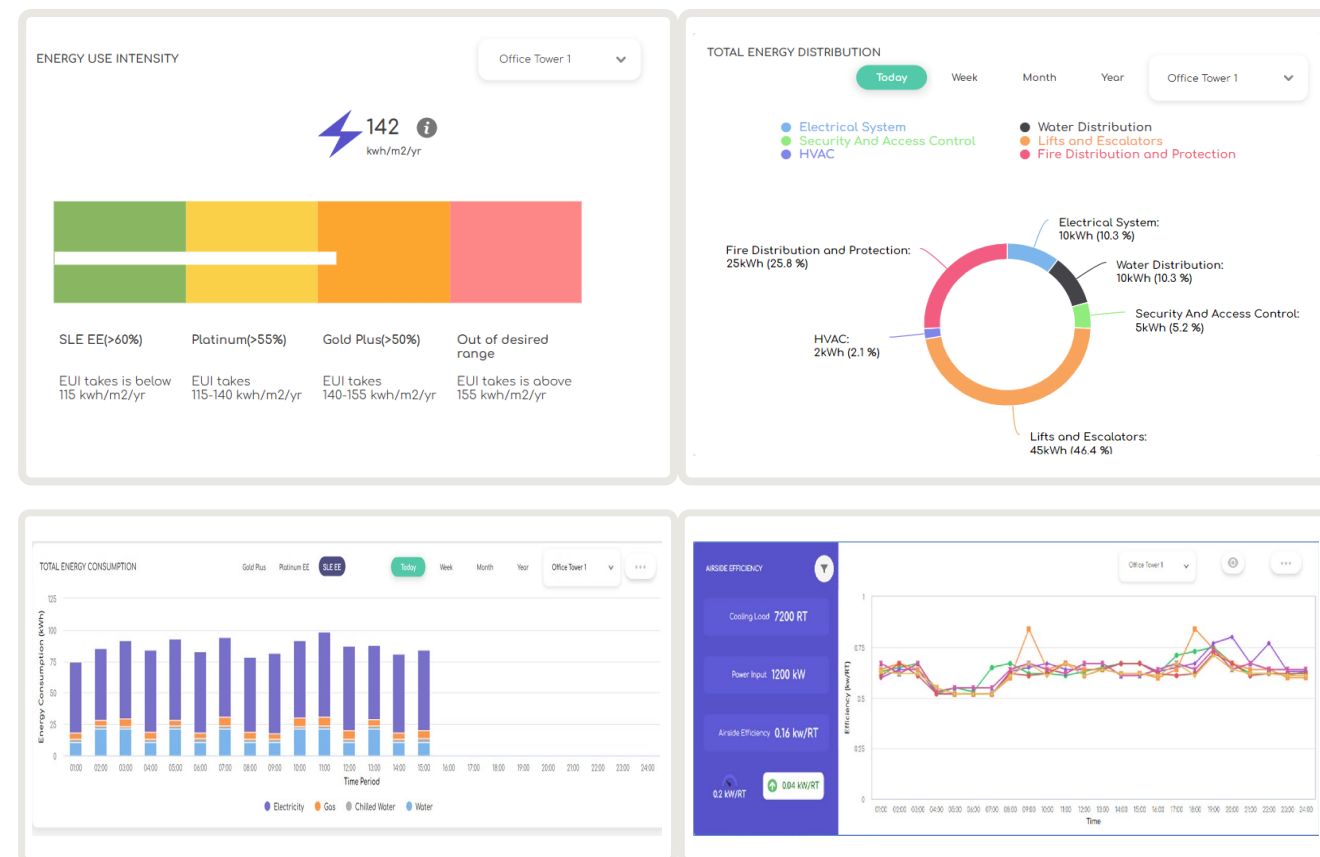


viii) Energy Monitoring

The users are able to monitor the energy consumption of the building in compliance with the Super Low Energy Buildings concept in Green Mark Certification, to identify the patterns in energy consumption, distribution of the total building energy consumption among building systems and any abnormal consumptions.

BENEFITS:

- Assists in monitoring the overall energy consumption of the building and individual building systems, and comparing the energy consumption with pre-defined baselines
- Helps in assessing energy consumption using different KPIs such as Energy Use Intensity
- Allows determining the status of the building in terms of energy consumption thresholds under different certification levels of Green Mark
- Enables comparison of energy benchmarks with reference models

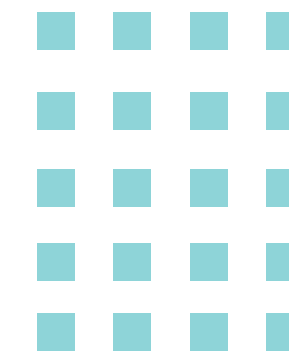


ix) Energy Predictions

The building's total energy consumption is predicted after analysing the historical energy consumption data through Machine Learning Algorithms. At the same time, indications are provided on how far the energy savings efforts have been effective in terms of accomplishing the required certification levels.

BENEFITS:

- Helps in determining the future energy consumption of the building based on accurate predictions using ML
- Assists the decision-making related to the effectiveness of the energy conservation strategies in terms of reducing the overall energy consumption of the building
- Helps to identify energy wastages to take remedial actions

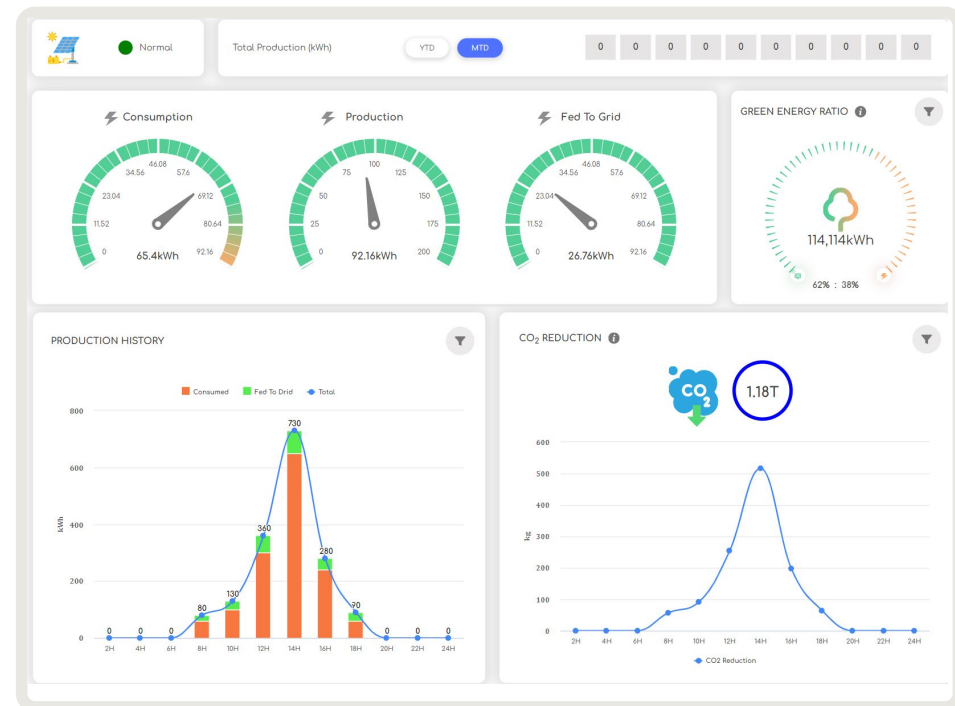


x) Green Savings/Renewables

The total contribution of the facility on the generation of renewable energy, both onsite and offsite is depicted with additional detailed information on renewable energy usage and CO₂ reduction.

BENEFITS:

- Enables tracking the renewable energy usage under production, consumption and fed to the grid amounts, along with the historical trends
- Assists the building owners and operators in enhancing renewable energy usage, paving way for sustainable building operations

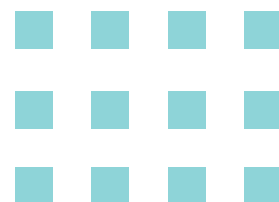
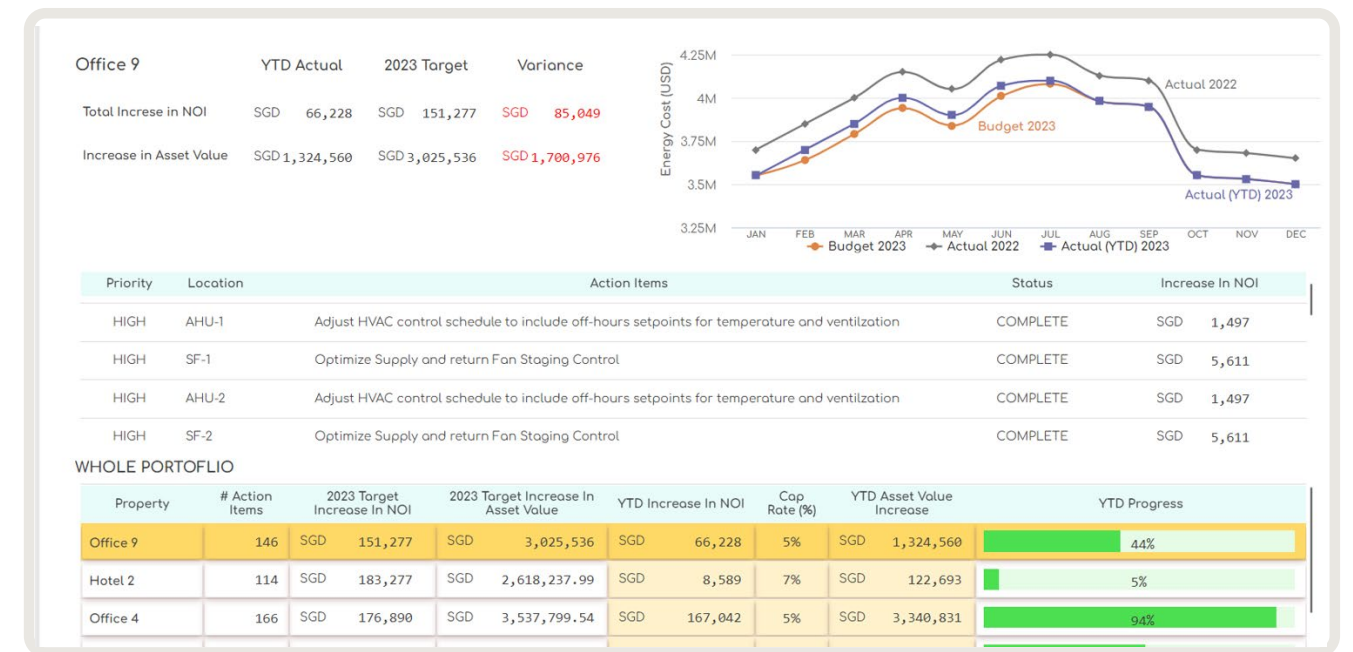
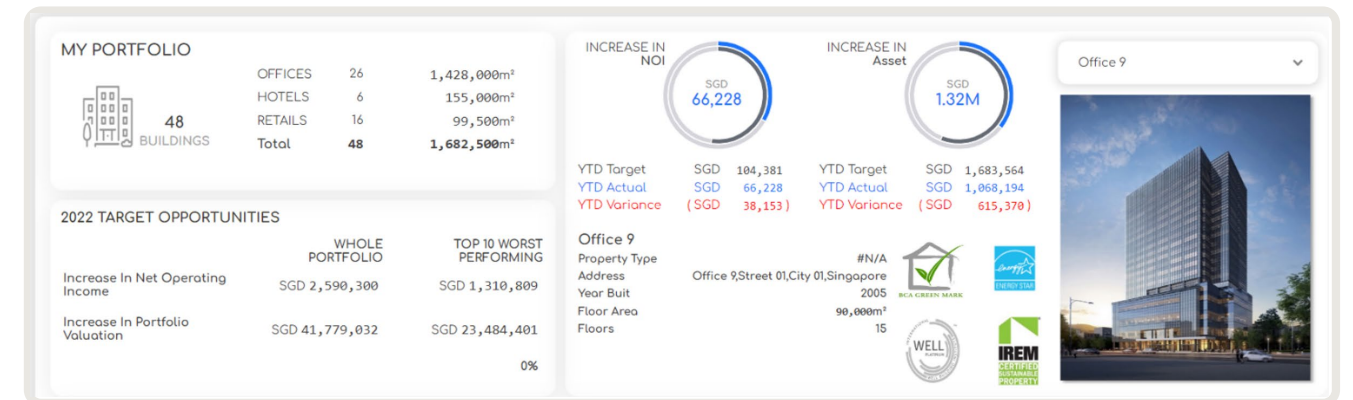


xi) Energy Optimisation

The effectiveness of the energy optimisation strategies in enhancing the financial performance of the building portfolio is assessed. The contribution of individual action items for energy conservation and other operational optimization strategies, on increasing the net operating income of the building is calculated.

BENEFITS:

- Helps in assessing the effectiveness of energy optimisation strategies on the financial performance
- Helps in decision-making related to energy optimisation in the building

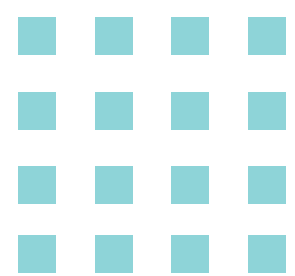
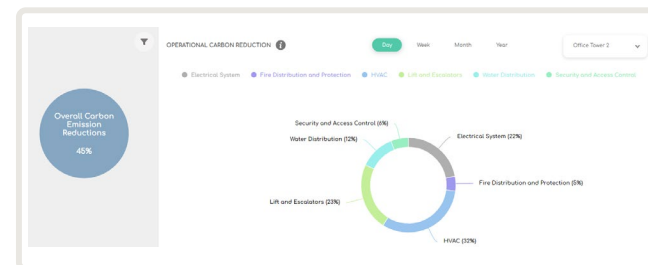
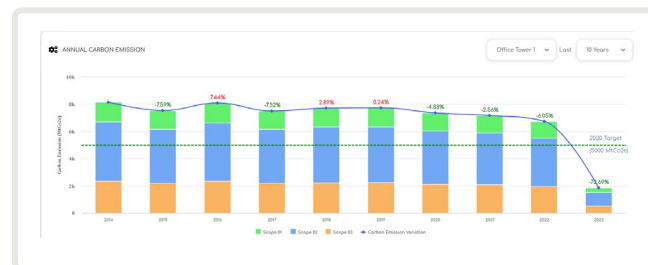
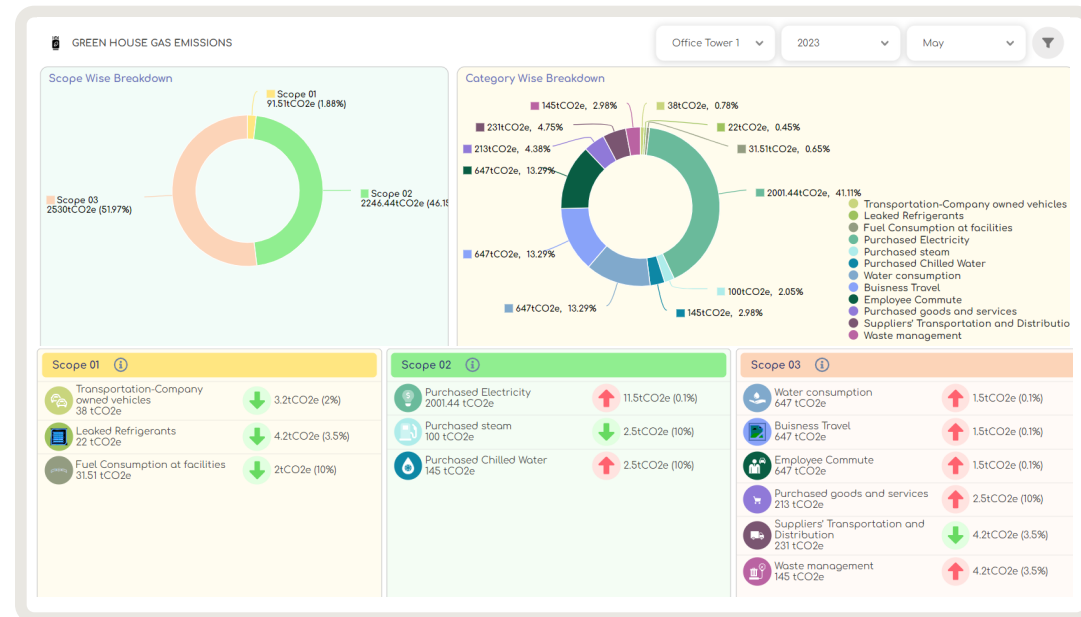


xii) Carbon Reporting

As we are moving towards the low carbon economy, our solution aims at assisting building owners to evaluate their transition towards carbon neutrality at the asset level, translating corporate objectives into tangible outcomes.

BENEFITS:

- Calculate the Carbon footprint with clear elaborations of contributing factors
- Assess their efforts against their target of reaching the carbon neutrality
- Reflects reduced carbon emissions via operational savings



www.iviva.com

iviva.C₂O

The Capricorn 1, Science Park Road,
#04-06 Singapore 117528



Like us on LinkedIn



Like us on Facebook

Tel: +65 8125 0644
Email: info.c2o@iviva.com
Web: www.iviva.com



Get in touch

with us via info.c2o@iviva.com
or +65 8125 0644 to discuss how
we can help your organisation