Using AI to Reduce Energy Consumption, Cost and Carbon Emissions in Data Centers

Leveraging energy-saving technologies to move closer to net zero.

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As the pace of technology accelerates, energy consumption and its associated costs impose growing concerns.

While companies wrestle with net zero plans, ensuring sustainable solutions that do not reduce performance or incur higher costs is crucial.

AI and machine learning are transforming everything, and World Wide Technology (WWT) expects that they will transform the way in which data centers are operated.

WWT has identified a new and AI-driven energy-saving product, ServerOptix® which claims that it can reduce data center energy consumption without compromising performance.

This paper outlines the testing undertaken by WWT in the Advanced Technology Center (ATC) during Q1 and Q2 2023, covering the background, approach, and methodology used, as well as the test results of the ServerOptix® product. We conclude with the potential contribution of ServerOptix® to a more sustainable path for technology growth.

Background

Data centers are indispensable in technological advancement

Growing demand for computing, networking and storage to deliver public and private cloud services such as artificial intelligence, Software as a Service (SaaS) and Application Service Providers (ASP) has resulted in a significant increase in the use of data centers for efficient execution of such intensive workloads.

Data centers consume a large quantity of energy. By some estimates, they contribute up to **2 percent of global carbon emissions.** Lighting, utilities, cooling, heating/ ventilation, and IT equipment require abundant financial and natural resources such as water and energy. Increasing pressures surrounding climate change, resource depletion and financial strains call for sustainable solutions to optimize energy efficiency and reduce emissions.

The amount of energy consumed by a data center depends on each server's load. Data centers consume energy to run, maintain and cool IT servers; Data center cooling can consume up to **40 percent of total power.**

This paper focuses on testing the effectiveness of an AI software solution to optimize power consumption while servers are running at a predetermined load.

WWT technical engineers are available to assist with any inquiries relating to liquid cooling technologies.

Leveraging the ESG-dedicated Advanced Technology Center Lab

Testing and analysis of the solution took place in WWT's ATC, which has a lab dedicated to sustainability testing and research.

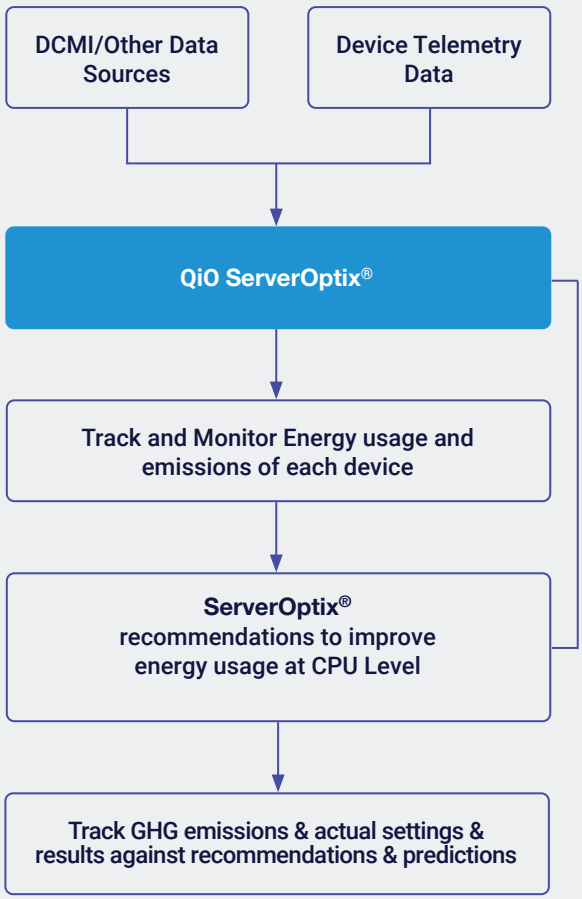
The ATC is a platform of physical and virtual labs created to foster a collaborative innovation ecosystem to design, build, educate and deploy innovative technology products and integrated architectural solutions.

The Solution - ServerOptix™

QiO Technologies is a leading Industrial IoT AI-based software products company that targets energy-intensive industrial companies, data centers and telecom providers.

In partnership with Intel, QiO Technologies has created ServerOptix® to address the energy efficiency and Scope 3 emissions within the IT equipment of data centers. The ServerOptix® product optimizes data center performance at the device level – maximizing production and quality while concurrently minimizing energy consumption, operating costs and CO2 emissions.

Figure 1.1:
shows a schematic overview of ServerOptix®



ServerOptix® with its inbuilt AI models is trained to monitor and learn server power usage and CPU utilization patterns intelligently. Consequently, ServerOptix® proposes (open loop) or automatically executes (closed loop) actions to adjust power consumption to meet the needs of
the server workloads more efficiently, without compromising operations or quality of service.

"As server usage has historically been managed conservatively to guarantee uptime and Service Level Agreements (SLAs), sleep states have not been utilized effectively Exploiting this fact with a data-driven optimization approach allows for significant energy consumption savings to be achieved without impacting QoS."

Gary Chandler
QiO Chief Technology Officer

Methodology

To ensure that the efficacy of the ServerOptix® could be seen across servers with varying utilization rates, the team installed the product on four WWT servers – 2x R650 and 2x R750 – each with a different pre-defined agreed load.

Each server model was tested with one flat and one varying load. This was done to prove that the product would have a positive effect in reducing power consumption across varying loads and load types.

Power draw data was rolled up every hour during the period of each experiment, where each row in the dataset was an average of the power draw for the hour. The QiO team directly read results from the motherboard, while the WWT team used the Power Distribution Unit (PDU) to validate the findings independently.

Steps:

1. Configure hardware for the testing
2. Determine pre-agreed loads for each server to run tests on
3. Data collection with ServerOptix® inactive -3rd April 9AM UK to 11th April 9AM UK
4. Data collection with ServerOptix® active – 11th April 9AM UK to 19th April 9AM UK

Promising results highlighting proof of value in saving energy use, costs and emissions

This experiment showed a general reduction in energy consumption across the four servers.

Servers with flat loads (650A, 750A) saw an average power draw reduction of 19-23 percent, and servers with varying loads (650B, 750B) saw a higher average power draw reduction of 27-29 percent.

The full results are as follows:

Server	Agreed Load	Avg. power draw ServerOptix® off (W)	Avg. power draw ServerOptix® on (W)	% Reduction	Remarks
021474 - R650B	20% Flat	312	240	23	
021262 - R750B	80% Flat	480	390	19	
021473 - R650A	20%/40%/60% changeable load	408	390	29	Peaks went from 432W to 312W (28% reduction) Troughs went from 360W to 264W (27% reduction)
021261 - R750A	50%/70%/90% changeable load (rotated every hour)	480	350	27	Peaks went from 510W to 360W (29% reduction). Troughs went from 450W to 330W (27% reduction)

Figure 1.2:

Power draw by server overtime (3rd April 9 AM UK – 19th April 9 AM UK) Left charts show flat loads, right charts show changeable loads

021474 - R650B **021262 -R750B** **021473 - R650A** **021261 -R750A**

As demonstrated by the charts above in Figure 1.2, starting 11th April, when QiO's ServerOptix® was activated, there was an immediate drop in power draw across all four servers, regardless of agreed loads or whether they were varying or flat.

Promising results highlighting proof of value in saving energy use, costs and emissions

To thoroughly vet the data, WWT ATC engineers also independently validated the impact of the product by collecting PDU data during the experiment.

Results captured in Figures 1.3 and 1.4 closely replicate the power draw drops shown in Figure 1.2; the power measurements taken at the PDU correlate strongly with the data collected from the motherboard, indicating that all four servers are running with considerably less power after implementing the product.

> **"Although tested using synthetic loads, these results are very positive with potential upsides to energy reductions noted."**
>
> **Jeff Gargac**
> WWT Technical Solutions Architect

Figure 1.3: System power PDU (W) across R750A (changeable) and R750B (flat load) servers

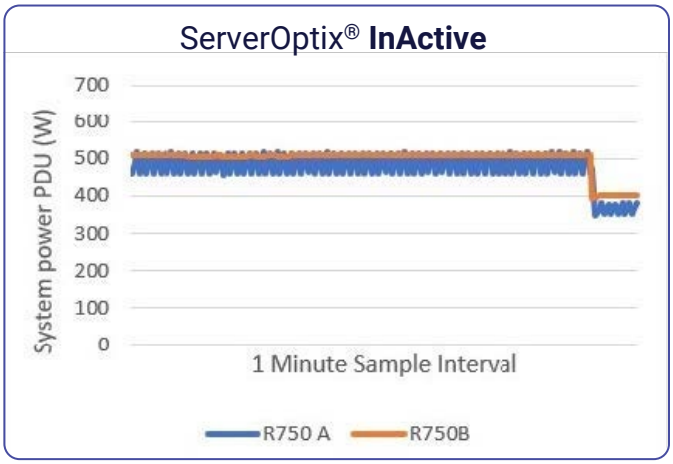
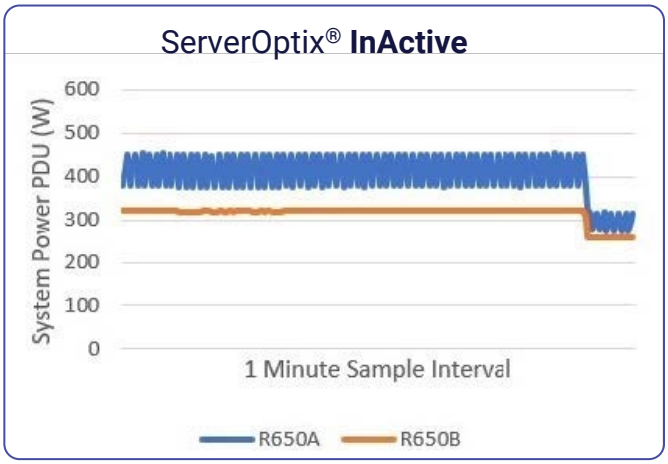
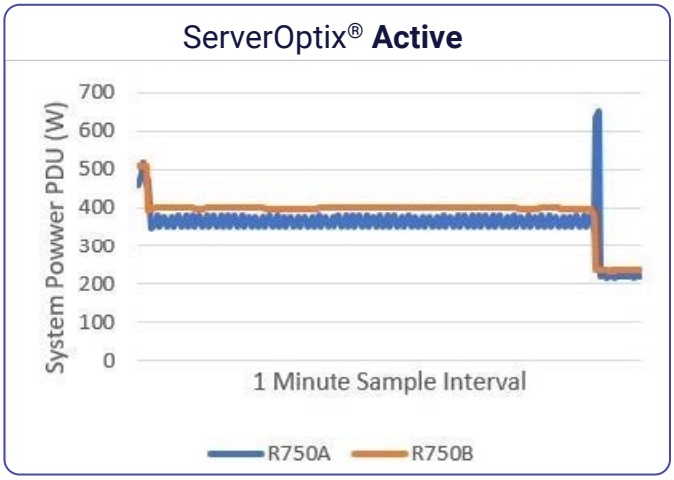
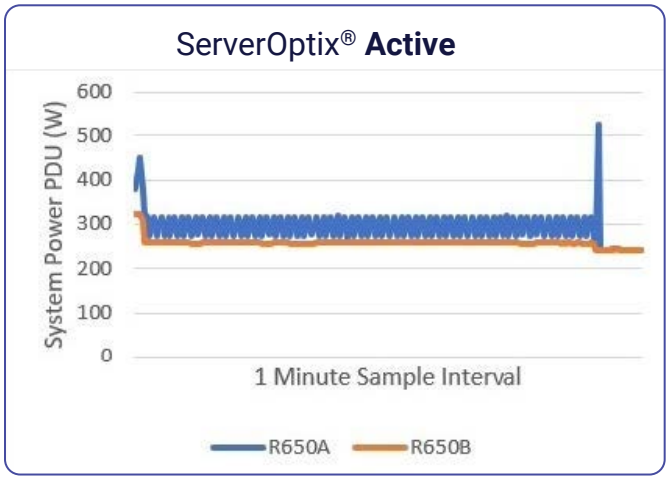


Figure 1.4: System power PDU (W) across R650A (changeable) and R650B (flat load) servers

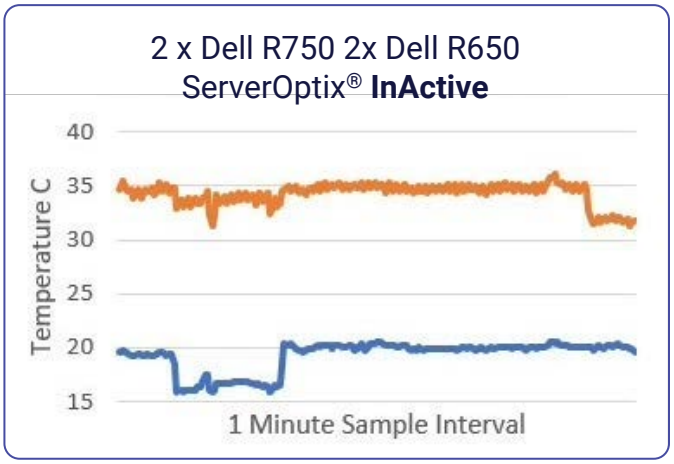


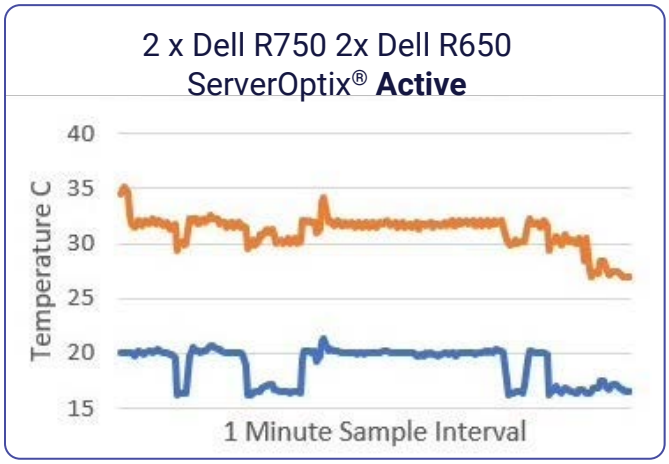




Additionally, the WWT team gathered other secondary data and observed changes before and after ServerOptix® was activated. For example, the temperature was collected as a key variable, and there was an average drop in the inlet temperature across all four servers when the ServerOptix® product was active.

Figure 1.5: Temperature changes across all four servers measured at the inlet & exhaust level





Before the product was activated, the inlet and exhaust temperatures across all four servers averaged 19.2 and 34.3 degrees Celsius, respectively. Starting 11th April – the average temperatures dropped to 18.9 degrees Celsius (inlet) and 31.1 degrees Celsius (exhaust), a 1.6 percent and 9.2 percent reduction.

The fall in temperature indicates another area where energy can be saved. WWT's prior research into using cooling liquid as a more sustainable and energy-efficient method of cooling servers investigated fuel and cost-saving benefits from better cooling technologies. Future research can further analyze the cascading effect of power draw reductions, reducing cooling requirements and consequently the energy required to drive cooling systems.

A future for more sustainable data centers

Results from this Proof of Value at the ATC Sustainability Suite demonstrate that the ServerOptix® product can reduce energy consumption in servers with both fixed and dynamic loads.

Furthermore, prior research has revealed that the ServerOptix® product also saves energy when the servers are idle, with Intel servers potentially seeing a 52 percent decline in energy usage while not being used.

WWT will continue to invest in and research ways to reduce energy consumption across data centers, helping our customers bring down energy draw, energy costs, and related carbon emissions and helping these customers accelerate their environmental & sustainability goals.

"Having tested this solution in WWT's Advanced Technology Center (ATC) Sustainability lab, where we are able to independently and objectively test hardware and software permutations, in our technical opinion, this solution merits serious consideration in the march towards making data centers more sustainable."

Chris Braun
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