

# Cold Hard Facts of Immersion Cooling – Part 2

People believed the Earth was flat for hundreds of years. Though the comparison is not quite as weighty, GRC finds that many infrastructure and operations professionals hold misplaced ideas about liquid-immersion cooling that linger to this day.

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# Cold Hard Facts of Immersion Cooling – Part 1

The advent of applications such as AI, IoT, AR, as well as microservices has many data center operators scrambling to find ways to break through barriers relating to rack density, power availability, location options, and data center design as a whole.

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## Drivers and Benefits of Modular & Micro-Modular Data Centers

Think modular / micro-modular data centers and you probably think about *edge computing*. But is the edge the only application that's driving the adoption of these solutions? The short answer is 'no', there are a lot more reasons why organizations are adopting modular and micro-modular data center solutions, however, the growing popularity and buzz around edge computing is playing an instrumental role in making these solutions growingly popular. This article will explore some of the key drivers and benefits of such solutions.

Let's first start by defining edge computing, the edge means many things to many people, but the way we look at it, it's **'the practice of processing data close to the data source and/or the end user'**, rather than in a central, traditional data center. According to predictions cited by our friends at Dell, analysts estimate that [75% or more of enterprise data](#) will be processed outside traditional data centers by the year 2022. With edge computing, data can be efficiently processed even in remote locations. And for many businesses, having a micro modular data center represents the new frontier.

Micro/modular data centers are essentially what they sound like: small mobile, prefabricated data center containers that can be placed just about anywhere. Most of the offerings on the market typically include complete data center infrastructure including cooling, power, and backup infrastructure packaged in a self-contained unit such as an ISO shipping container or a custom rack enclosure. These modular data centers can range from single rack systems supporting a few kW of IT or larger systems supporting multiple racks and hundreds of kilowatts of IT load. And while mobile, modular data centers aren't the newest solution available, they've seen a huge uptick in mainstream adoption lately: over the last three years, they've experienced a [compound annual growth rate](#) of 42%. This begs the question:

# What's driving the popularity of modular and micro-modular data centers?

Here's what we at GRC, are seeing in the market:

## What's Driving The Popularity of Modular and Micro-Modular Data Centers?

## Location Flexibility



### 01 Location Flexibility Get Closer to the Data Source

*New age applications are pushing organizations to get closer to the data source and/or the end user.*



### 02 Speed & Agility Quicker Deployment Time

*Modular data centers allows for deployment in weeks instead of months.*



### 03 Cost Efficiency Grow As You Go Solutions

*Being pre-fabricated and often mass-produced helps them be more cost-effective than custom designed traditional data centers.*



### 04 A Turnkey Solution Complete Infrastructure

*Focus on core competencies without having to worry about infrastructure becoming a bottleneck or resource drain.*

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New age applications are pushing organizations to get closer to the data source and/or the end user. Whether you're a high frequency trader trying to be close to the exchange, a military organization looking to get compute power in the battlefield, a manufacturing company processing IoT data on the factory floor, a streaming service looking to cut down latency, or supporting AI based self-driving cars, more and more organizations are looking for greater location flexibility, which is driving them towards modular solutions for the edge.

## Speed & Agility Are More Critical Than Ever

Beyond defense applications where rapid deployment can become a huge strategic advantage, more and more commercial organizations are looking towards turnkey modular and micro modular solutions to help cut data center construction and deployment time. Traditional data center builds can take up to 18 months to build from planning to commissioning. Modular data centers allow deployment in weeks allowing businesses the agility to quickly respond to market needs while making capacity planning and forecasting easier.

## Costs, Constraints, and Complexity Are Rising

Location, power, and cooling constraints are making traditional infrastructure growingly complex. As we add more systems to tackle each of these constraints, we end up increasing not just costs but also complexity and the potential points of failure. For example, air-side economization is a popular method to reduce air-

conditioning needs but brings up other challenges such as stratification, humidity, and contaminants, which in turn mandate the need for additional systems to control the mixing, humidity, and filtration of incoming air. And while, not all modular and micro-modular solutions address complexity issues, being pre-fabricated and often mass-produced helps them be more cost-effective than custom designed traditional data centers. In addition to being lower cost, micro/modular data centers also enable capital deferment by allowing you to ‘grow as you go’. The lower cost basis makes modular data centers a growingly popular choice, not just for edge and greenfield builds, but also for augmenting the capacity of space constrained data centers, and for adding high density zones in legacy facilities.

## **Turnkey Solutions Make Life Easier**

Apart from the strategic, technical, and financial benefits of modular and micro-modular data center solutions, they also make the whole process of deploying data center and compute capacity a lot easier. This helps businesses focus on their core competencies without having to worry about infrastructure becoming a bottleneck or resource drain.

## **What Gives GRC The ‘Edge’?**

There are numerous modular and micro-modular data center solutions on the market today, picking the one that's right for you can be a daunting task. Here are a few reasons why we at GRC believe that our patented immersion cooling technology, and over a decade of global deployment experience, help us better meet your needs:

## What Gives GRC The 'Edge'?



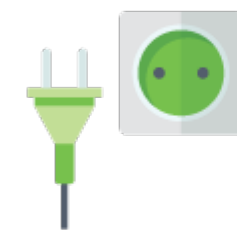
### 01 Environmental Resilience Protects with ElectroSafe™

*ElectroSafe™ coolant encapsulates servers protecting them from dust, moisture, vibrations, hot spots, and oxidation.*



### 02 High Density Support Put REAL Compute on the Edge

*GRC's modular data centers remove constraints of rack density, supporting 25 -100+kW per rack.*



### 03 Efficient Operation Maximization of Available Power

*<1.05 mPUE virtually anywhere on the planet and a 10-20% reduction in server power consumption with GRC's immersion cooling solutions.*



### 04 Cost-Effective OPEX & CAPEX Savings

*GRC's ultra-efficient immersion cooling technology eliminates costly air conditioning equipment, humidity and environmental controls, etc.*



### 05 Easy Deployment Easy Operation Minimal Site Requirements

*All you need is power, network, and a water source to get going. Plus, all GRC products come pre-integrated with a number of standard features to make your life easier.*



### 06 Configurability and Flexibility GRC's ICEtank™ and HashTank™

*A range of options and configurations to choose from; 2 to 8 racks, 25 to 100+kW per rack cooling capacity, redundancy options, cooling-tower/radiator/hybrid-cooler options, smart/basic PDUs, integrated/standalone UPS, backup generator, ATS, and more.*

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## Unmatched Environmental Resilience Delivers Complete Location Flexibility

Imagine landing a chopper next to an air-cooled data center in the middle of a desert! Not the most comforting picture, but GRC's patented immersion cooling technology inherently protects servers immersed in the [ElectroSafe™ coolant](#). ElectroSafe™ encapsulates servers protecting them from dust, moisture, vibrations, hot spots, and oxidation, thereby offering unmatched environmental resilience that gives you the ability to drag and drop computing capacity, even in the harshest of environments.

## High-Density Support That Allows You to Put REAL Compute on the Edge

Ever-evolving technology and new-age applications are among the leading drivers for edge computing, and as servers get more powerful to meet growing compute needs,



they also get hotter. Unlike air-cooled data centers, GRC's modular data centers remove constraints of rack density, supporting 25 -100+kW per rack! This high density support allows you to put real computing power to support all your applications on the edge.

## Ultra-efficient Operation Enables Maximization of Available Power

GRC's modular data centers offer unparalleled efficiency, delivering <1.05 mPUE virtually anywhere on the planet. In addition to the ultra-efficient cooling, GRC's immersion cooling also enables a 10-20% reduction in server power consumption through fan removal. Given that power is rarely cheap at the edge, this can result in considerable OPEX savings. Further, the lower peak power requirements allow for maximization of the available power envelope.

## Simple = Cost-effective

In addition to OPEX savings offered by GRC's ultra-efficient immersion cooling technology, the technology also enables CAPEX savings by eliminating costly air conditioning equipment, humidity/environmental controls, etc. And through downsizing of power and backup infrastructure in proportion to the peak power reduction. The end result is a high-efficiency, high-performance modular data center that doesn't break the bank.

**Watch & Learn: A Closer Look at  
Modular Immersion-Cooled Data Centers**

## Easy to Deploy, Easy to Operate

GRC's turnkey modular data centers have minimal site requirements, all you need is power, network, and a water source (water-free radiator options are also possible). Further, all GRC products come pre-integrated with a number of standard features to make your life easier:

- [Foresight remote monitoring software](#) allowing remote /'lights out' operations.
- Complete electrical distribution and infrastructure
- Integrated server lifts and rack service rails for easy hardware maintenance
- Fire detection/suppression systems

## Configurability and Flexibility

GRC's [ICEtank™](#) and [HashTank™](#) solutions also give customers a range of options and configurations to choose from; 2 to 8 racks, 25 to 100+kW per rack cooling capacity, redundancy options, cooling-tower/radiator/hybrid-cooler options, smart/basic PDUs, integrated/standalone UPS, backup generator, ATS, and more.

Overall, modular and micro-modular data centers address a number of technical and business challenges faced by data center operators across the globe, today. GRC's [ICEtank™](#) and [HashTank™](#) solutions further remove constraints of power, cooling, location, and costs over their air-cooled counterparts. With deployments in five countries, GRC's immersion enabled modular data centers are helping leading organizations, including the US Air Force, break through the limitations of traditional data centers.

To learn more about how the US Air Force tested and deployed GRC's ICEtanks, [download the case study from the Air Force Testing Authority](#), or send us an email at [info@grcooling.com](mailto:info@grcooling.com).

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# GRC Celebrates Ten Years at the Epicenter of Liquid Immersion Cooled Data Centers

As GRC turns ten, we take this opportunity to thank you for helping us succeed! Going from start-up to scale-up definitely calls for celebration. It also calls for forward thinking because, without question, our greatest accomplishments still lie ahead of us.

It is truly exciting and heartwarming to see what we have accomplished and where we've reached in our decade of existence. Back in 2009 when the first generation CarnotJet System was launched it was a true paradigm shift in terms of the simplicity of the solution and the resulting power, cost, and time efficiency it offered. Now, with millions of hours of customer runtime under our belt, the eighth-generation products, the [ICEtank™](#) and [HashTank™](#) container solutions and the [ICEraQ™](#) and [HashRaQ™](#) immersion systems, are continuing the tradition of powerful and cost-effective cooling solutions while driving company growth by nearly 500% in 2018.

We now have installations across 13 countries and are working with partners in Europe, Asia, and the Middle East to continue growing our global footprint. We are thrilled to have supported our incredible international customer base for the past decade and look forward to continuing doing so for decades to come.

As we look back at all the successes we've had over the years and all the awards we've won, the most satisfying indicator of success is our ever-growing list of happy customers who continue to grow with us.

From all of us here at GRC, we'd like to thank you for all the support and feedback that has helped us get where we are today. We look forward to working with you as we write the next chapter of our growth story as *The Immersion Cooling Authority*.

Best regards,

Peter Poulin  
CEO

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## Different Ways to Mine Cryptocurrency

Generally, the idea of mining cryptocurrency is already a bit confusing and complicated. But even more so, people on the outskirts of the crypto mining community do not normally think about the different ways there are to mine crypto (which can be even more bewildering). This article will simply highlight the progression and advances in mining technology so you can be a crypto mining expert.

### The Beginning of Crypto Mining

In the grand scheme of things, Cryptocurrency hasn't been around for very long. It's only been 10 years since the first cryptocurrency, bitcoin, was created. August 2008, the domain name bitcoin.org is registered, and later that month a cryptic person by the name of Satoshi Nakamoto publishes a paper called "Bitcoin: A peer-to-peer Electronic Cash System. The first bitcoin transaction happens on

January 12 2009, when Nakamoto sends a computer programmer by the name of Hal Finney 10 bitcoin.

Cryptomining attempts to solve complex mathematical equations that are a part of the blockchain encryption mechanism. The first individual or group to solve these compound algorithms gets rewarded a block. For example, a bitcoin block has 12 bitcoin. Each bitcoin is currently worth over \$6,400. The most powerful mining rigs are able to mine the most cryptocurrency.

## Next Level Power

Before mining bitcoin was available to the public. The small [cryptocurrency community was mining bitcoin from their CPUs](#). In December of 2009, Nakamoto published a letter that said, “We should have a gentleman’s agreement to postpone the GPU arms race as long as can for the good of the network. It’s much easier to get new users up to speed if they don’t have to worry about GPU drivers and compatibility. It’s nice how anyone with just a CPU can compete fairly equally right now.”

Most people believe that a person with the pseudonym, ArtForz, was the first person to mine bitcoin with GPUs, but there are conflicting stories that have Lazlo Hanyecz actually doing it a couple months before. Artforz is also thought to have used FPGAs and early structured ASICs to mine over 26,000 bitcoins over the course of 9 months.

In 2010, Hanyecz infamously traded 10,000 bitcoins for a couple pizzas. Eight years later, these two pizzas are worth over \$8.6 million.

Later that year, the code for mining bitcoin was released to the general public.

In 2011, other cryptocurrencies begin to emerge including Litecoin, Namecoin, and Swiftcoin.

During this time, GPUs were still the most widely used among miners. Normally used for rendering video, animation, and images—the extra processing power was great for mining. It was efficient and fast, but wasn’t as flexible as a CPU, and it also requires more specialized programming to leverage its power, but it is noticeably more powerful on many accounts. It usually contains thousands of cores that are very capable of performing repetitive tasks at a high level. GPU mining rigs are powerful computers that can be modified to mine any cryptocurrency.

## Professional Mining Power

Because most people used GPUs to mine crypto, people were looking for faster and more efficient ways to mine the currency. By [2011, Field-Programmable Gate Arrays became more popular](#).

After a bit of configuration troubleshooting, miners were able to successfully use FPGAs to mine cryptocurrency effectively while using less power.

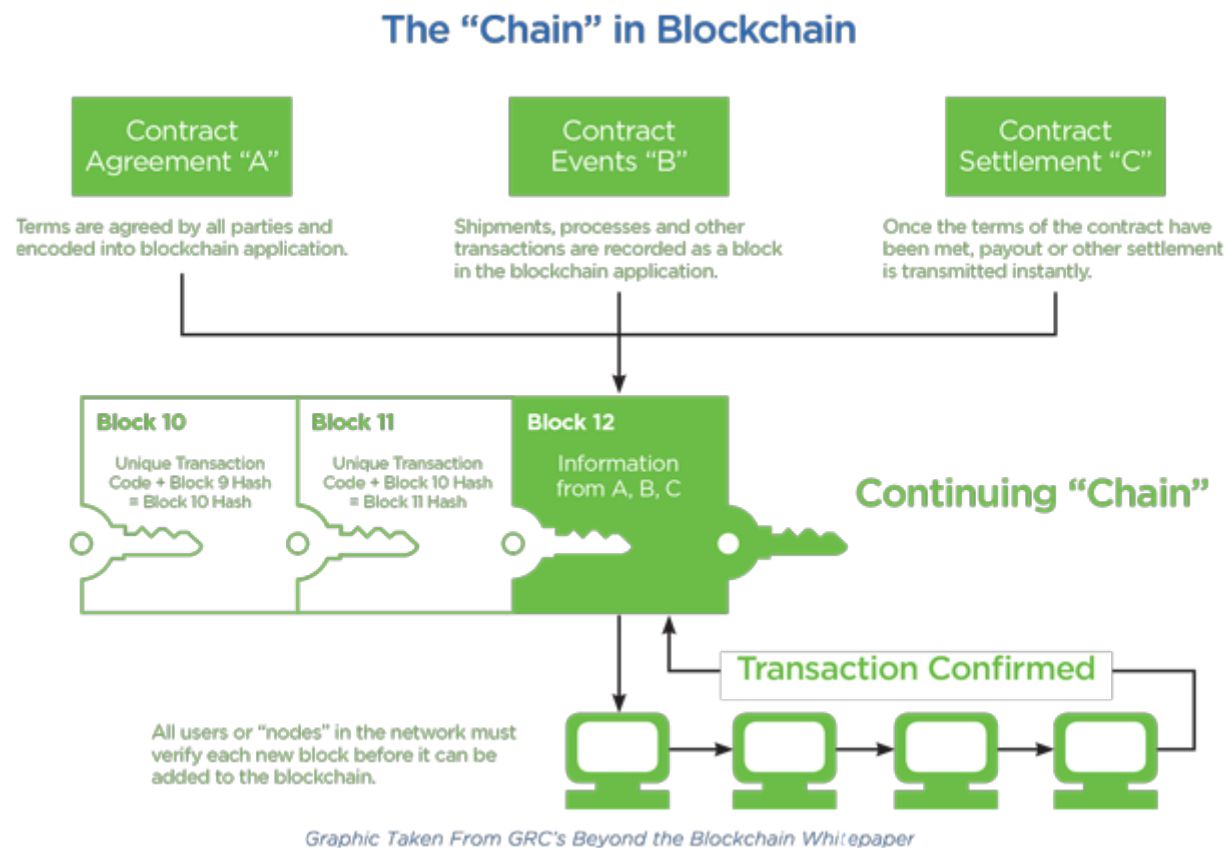
While, these machines were powerful at the time—mining at a speed of around 25 GH/s—they were also extremely loud, needing massive cooling fans.

FPGAs are quite popular because they can implement any logical function. However, FPGAs need to use software called HDL or Hardware Descriptive Language. This program is used to program the devices including gate arrays and static IP, but having to do it manually has become a burden to many miners. FPGAs are a great way to mine crypto, but it has been hard to compete with modern professional mining rigs. This is where modern ASIC mining rigs come into the picture.

ASIC or [Application-Specific Integrated Circuit Miners](#) are known as professional

mining computers. FPGA and ASIC systems have many things in common. First off, they are their own form of processing chip. These chips are used specifically to mine cryptocurrency without any other functions. They can both process logic-based operations, and can use power more efficiently than previous CPUs and GPUs. Unlike a GPU mining rig, ASIC miners are designed to solve for one specific algorithm. This can be positive or negative. By narrowing down the algorithm focus, the miner uses less electricity and is usually cheaper than most GPU rigs. ASIC miners will earn more per day than any other system. Here are some [examples of the best hashing or mining power](#) from each:

CPU (Intel i7 2600k) – H/s: 49



GPU (AMD Radeon 6990 Pro 4GB) – H/s: 84,000

FPGA (Xilinx Spartan6 CM1) – H/s: 1,6000,000

ASIC (KNC Miner Juptier) – H/s: 400,000,000

As you can see, ASIC miners are the most powerful of the lot. Some other good examples of ASIC miners are the Bitmain Antminer S9i and S9i, Antminer S7, AvalonMiner 761, and the WhatsMiner M3.

## Cooling Innovations and Costs

The power & cooling costs it takes to mine cryptocurrency is astounding. Because the servers used to mine cryptocurrency are being worked to their maximum capabilities—these servers need the most advanced cooling systems available. Green Revolution Cooling, who patented liquid immersion cooling technology, has seen an incredible growth in sales over the past year. According to Data Center Knowledge, last year, GRC increased their revenue by five times what it had been the past year. Many of these sales can be attributed to the mining of cryptocurrencies, and the launch of their new products GRC's HashRaQ, designed as a single rack immersion system, and the HashTank, a six-rack immersion system.

Mining cryptocurrency can be very costly with energy expenses alone. For example, [Antonio Villas-Boas from Business Insider](#), put together a small mining rig that can mine 0.0015 bitcoin a day. His small setup has an electricity cost of \$5.32 a day or about \$1945 a year. He currently makes \$4500 in mining each year with a gross of \$2555.

GRC's immersion cooling systems can reduce build-out costs by as much as 50% and lower cooling energy costs by up to 95%. Many people are taking advantage of these numbers and increasing their overall mining profits.



# Conclusion: What's Next?

As long as mining for these algorithms are profitable—people will continue to innovate their rigs to be more powerful. We don't quite know what the future holds for the cryptocurrency, but for now, it looks promising.

From CPUs to GPUs, and FPGAs to ASICs. Mining is getting more powerful. Along with this—we also see major advancements in the field of server cooling. Immersion cooling systems are allowing miners to hash at speeds that were unthinkable when cryptocurrency mining first came to be.

*Michael Isberto is the Blog Director and a Content Writer for [Colocation America](#). He received his B.A. in Communication Studies with an emphasis in Public Relations at CSUSB. Isberto is a Communication professional with additional experience in Public Relations, Marketing, and Social Media.*

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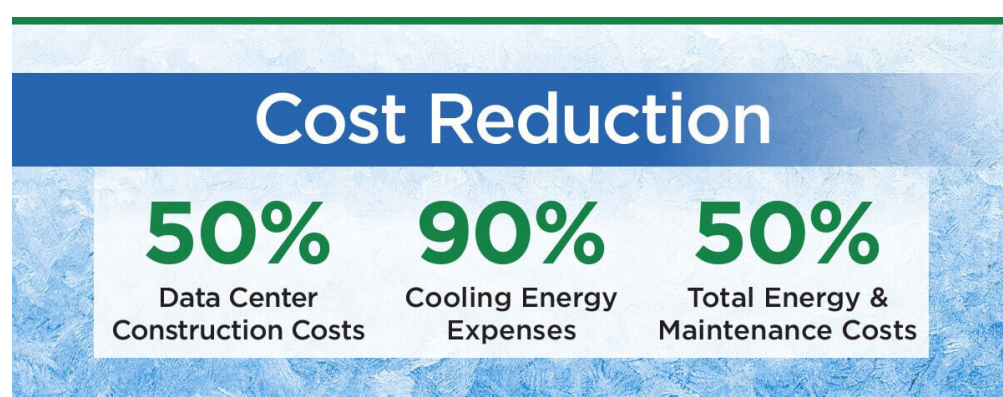
## Data Center Liquid Cooling Myths – Busted!

### INTRODUCTION:

You may have heard a few exemplary facts about liquid-immersion cooling technologies – like our [ICEraQ system](#) – such as its **incredible CAPEX and OPEX savings**. However, you also may have heard some things that made you unsure about this technology. Today we dispel some of the myths about Single Phase liquid-Immersion Cooling, and set things straight with the facts about our offerings.

❑ **MYTH – Liquid Cooling is more expensive than traditional A/C**

❑ **FACT –** The [ICEraQ system](#) has helped many satisfied customers **build out data centers for as much as 60% less** than traditional air-cooled data centers, **plus continually provide them with significant cost savings on energy and maintenance.**



❑ **MYTH – It's not safe**

❑ **FACT –** Green Revolution Cooling (GRC) uses a clear, odorless, non-toxic mineral oil-based coolant called ElectroSafe, which does not conduct electricity but is a good conductor of heat, making it ideal for cooling IT equipment.

Download our [ElectroSafe Coolant Fact Sheet](#)



*Our ElectroSafe coolant is non-flammable, non-toxic, completely dielectric and safe.*

❑ **MYTH – It makes operations tougher**

❑ **FACT** – We made the system operationally simple. The open system design of the racks enables **quick access to server equipment**, and the movable server support bars facilitate hot swapping of components over the rack.

❑ **MYTH – It's new and untested**

❑ **FACT** – Perfected over the course of a decade, the [ICEraQ system](#) has been installed by some of the [world's biggest operators in a breadth of industries](#), including 3 of the top 10 telecoms, one of the largest search engines on the web, government agencies such as the DoD, Air Force, NSA, and top super-computing facilities.

Take a look at our [featured clients & see what they're saying about us](#)

## Global Presence

Our Deployments Are in **Eighteen** Countries World-Wide:



*First deployed in 2010, ICEraQ system is now used in cutting-edge data centers around the world.*

❑ **MYTH – It limits hardware options**

❑ **FACT** – The [ICEraQ system](#) supports rack-based servers from all major OEMs, and requires only fan removal for submersion.



❑ **MYTH – Liquid cooling is only for high density facilities**

❑ **FACT** -While it is true that support for high density servers (over 100kW/ rack) is one of the unique benefits of our immersion cooling technology, there are several other benefits that drive the adoption of the technology. Our immersion cooling solutions help radically simplify data center design, construction, and operation allowing for reduction in both upfront and operating costs.

Further, the modular design allows for easier capacity planning and edge deployments, even in the harshest of environments. Immersing servers in our ElectroSafe coolant protects them from dust, moisture, oxygen, hot-spots, and vibration, thereby providing unmatched environmental resilience.

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## CONCLUSION:

While there are many opinions on immersion cooling, it's important to know the facts of the matter – simply put, GRC's patented immersion cooling solutions radically simplify the design, build and operation of data center cooling infrastructure, while also removing the limits of rack density, power availability, and location options.

Was there a specific myth you've heard that you don't see on this list? Let us

know! Or, if you would like to know more about how GRC solutions allow companies to build and operate more efficient and cost-effective data centers, [Contact Us](#) and a GRC representative will reach out directly to answer your questions.

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# Transforming Data Centers with Blockchain

Traditional data centers aren't always able to meet the demands of a large number of users who need to retrieve data in real time. The dramatic increase in the use of big data is putting pressure on data centers to increase their data transmission speed to accommodate more internet users. Data centers are therefore shifting from storage to real-time data analysis on demand as their primary function.

This functionality shift makes blockchain an increasingly attractive option for verifying data set changes across multiple data centers. However, this approach also requires an infrastructure that can provide rapid, secure data transmission for sources that require high bandwidth such as data, video and voice. Many data centers are now changing their traditional network architecture to one that can accommodate the data processing demands of block chain systems.

## Infrastructure Changes

Traffic in traditional data centers is primarily between clients and servers, but server-to-server traffic predominates in internet data centers that support cloud-computing applications. Internet data centers must also provide an uninterrupted experience for a large number of users with diversified demands. The network architecture of these data centers therefore needs to be more efficient to handle the traffic spikes they routinely experience.

The architecture currently in use by most data centers is a tree network consisting of three levels, including core, aggregation and access layers. This model can be effective when transmissions are primarily between client and server, but less so for applications requiring high bandwidth where latency becomes a concern. Large data centers are now migrating to a spine-and-leaf network architecture, which is more efficient at transferring data directly between servers.

However, the cabling for this architecture is much more complex since a leaf switch is needed to connect each spine switch. The main distribution area (MDA) of a data center using a spine-and-leaf architecture also has a higher server density, which requires greater cooling capacity. An MTP-to-LC module is beneficial for this architecture, since it can achieve the full mesh of the leaf switches without breaking the spine switch's 40G port into four 10G channels.

Data centers will be able to secure their data more effectively once their infrastructure can support the required traffic. Blockchains are becoming a popular solution to data security, since they distribute data across multiple servers using cryptographic methods. This approach makes blockchains difficult to hack, since each block typically contains only a cryptographic hash of the previous block. Blockchains were originally used to protect cryptocurrencies such as Bitcoin, but they're also being used to provide data security outside the financial sector. Data centers that store sensitive data have been among the first to adopt blockchains as a secure storage method.

## Future Demands

Data center infrastructures will need to support many more devices with internet

connectivity due to the increasing proliferation of 5G networks and the Internet of Things (IoT). They will also need to meet the demands of increased traffic and secure storage during this transformation. A spine-and-leaf network architecture will provide an economical solution to distributed data management through the use of servers that can tolerate higher densities. This architecture has already enabled large data centers to upgrade their bandwidth from 10G to 40G and will help ensure the transition to 100G networks in the near future. Data centers will adopt blockchain technology to improve the security of their data storage.

## **Conclusion**

Green Revolution Cooling's liquid-cooled server racks can help you use blockchain technology in your data center by reducing build-out costs as much as 60 percent and cooling costs by up to 95 percent. Our immersion cooling systems provide up to 100 kW of cooling power per rack, allowing you greatly increase hardware density. GRC's modular, pre-engineered solutions also allow you to deploy in any powered shell, including warehouses and breweries.

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# **Podcast: GRC Talks About CleanTech Marketing**

Our Director of Product Marketing, Dhruv Varma, was recently featured on a podcast called "The Good Stuff And The Noise" hosted by INK Communications Co. #heyinkco. Listen to Dhruv's thoughts on #Cleantech marketing, and about GRC's journey from an early stage startup to a thriving data center infrastructure company, solving real-world problems for customers ranging from the US Air Force to #Bitcoin miners, and everyone in between.