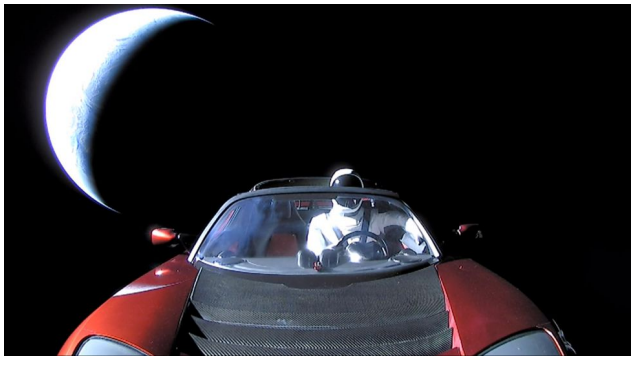
Highlights

Data is growing exponentially and, with it, the need for storage – and, lots of it! There has been concern about chip shortages, now the depletion of helium reserves (integral to semiconductor manufacturing), and the need for a more climate conscientious tech market. As Bezos, Musk, and Branson launch rockets into space, people have questioned the seemingly solely ego-driven race to space. Yet, each are also committing to driving technology for enterprise storage technology in space – with the promise of meeting global climate action objectives and anticipated data demands on the horizon. Elon Musk launched his Tesla Roadster on his $500M Falcon Heavy's first flight, with live video feed for four hours before the batteries ran out.

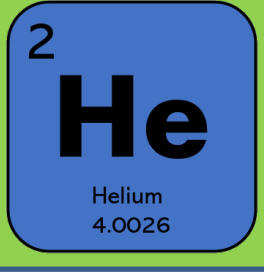


This newsletter looks at the helium "crisis", hydrogen space flight, and the race to place datacenter satellite services and storage above the clouds.

Cheers! Mike Heumann

Is the sky falling?

Well, I suppose that would help.



Bezos, Musk, NASA, Intel, NVIDIA, Netflix, Amazon, Google, and many others are helpless without it. Crippled, done, nada. What is this "magic" ingredient that is so necessary for their current success? Helium. Not just for kids balloons and silly voices, helium is integral to our major technological advances today. Netflix stores its data on 36 helium-filled drives that hold about 100TB of data. Helium increases hard drive storage capacity by 50% and reduces power consumption while doing it.

There have been numerous articles about depletion of helium reserves, increasing global demand, and other doom and gloom, the sky is falling, rhetoric. The fact is there are many advances in global production. And, worst case, the moon is full of Helium-3, which is extremely rare on Earth but 100 million times as abundant on the moon. So, a few more rocket launches, and we can tap that resource along with all the other unique minerals available there.

Hydrogen and helium make up 98% of the matter in the universe. The sun is approximately 75% hydrogen, 25% helium, plus traces amounts of oxygen, carbon, neon, nitrogen, magnesium, iron, and silicon. But, hydrogen is highly flammable (i.e. Hindenburg), limiting its usability.

Helium is the second lightest and second most abundant element and...

has the lowest boiling point of any element and cannot be solidified by lowering the temperature (which makes it popular as a cooling source for MRIs and electronics);

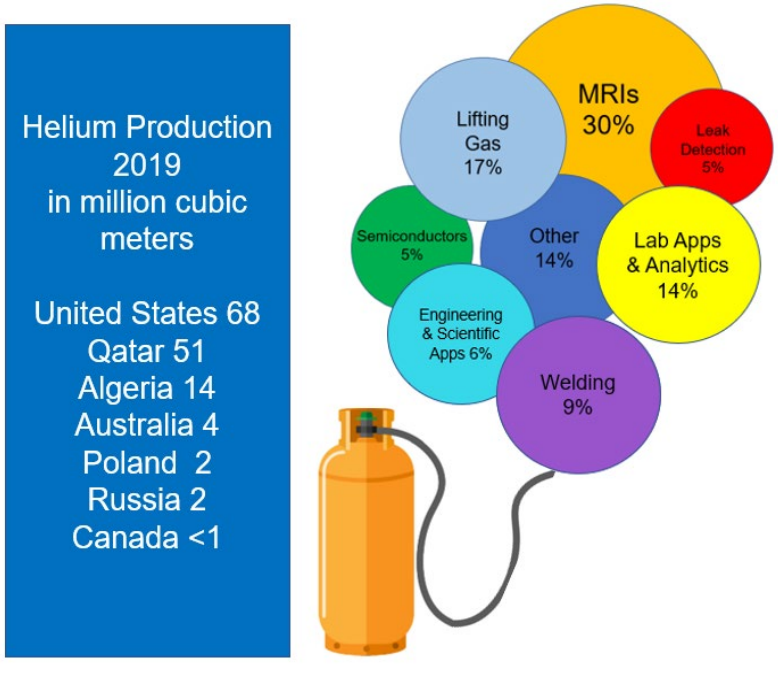
extremely abundant in space because it is so light; it is present in all stars;

most helium on Earth is the result of radioactive decay;

the greatest concentrations are found in natural gas, with concentrations as high as 7%.

In 1903, an oil drilling operation in Kansas produced a gas geyser that would not burn. Chemists determined that the material included a concentration of 1.84% helium. This led to extraction of helium as a byproduct of natural gas, primarily for military use. Military uses today include cleaning up noisy signals in submarine detectors, reference point for heat guided missiles, spectroscopic and imaging, purging/pressurizing propulsion of rockets tanks, and cooling thermographic cameras.

The government established the National Helium Reserve in 1925 in Texas and banned the export of helium during times of scarcity. The Bureau of Land Management built a 425-mile pipeline from Kansas to Texas to store helium. By 1995 a billion cubic meters of the gas had been collected and the reserve was $1.4 B in debt leading to the desire to phase out the reserve. These reserves will be depleted by September 2021 as we move solely to privatization of helium production and storage.



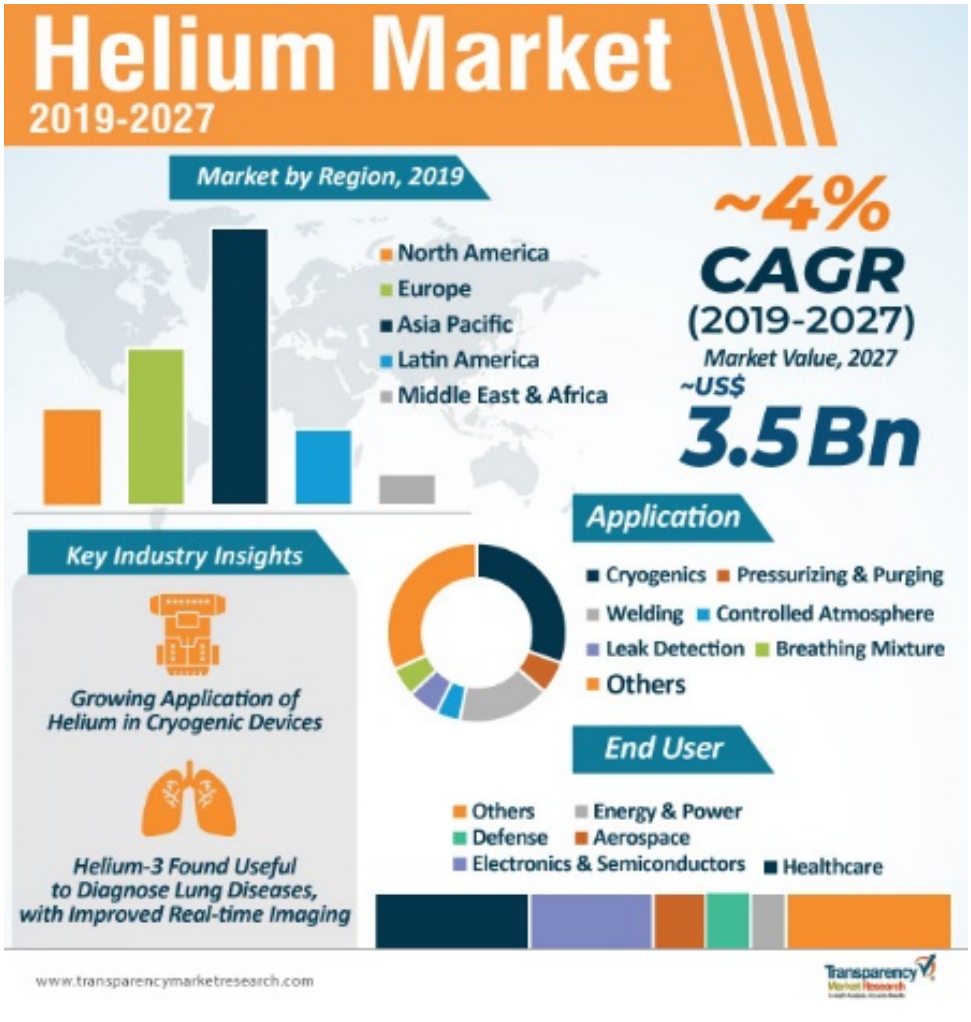
Common uses for helium include hard drives, space flight, cooling magnets in MRIs, detecting leaks in air conditioners, scanning barcodes, preventing bubbles from getting trapped inside fiber optic internet cables during development, cooling and processing silicon during creation of semiconductor chips, specialized welding, missiles, rockets, observation balloons, and to inflate car airbags after impact.

Global demand is predicted to grow at a CAGR of 4.65% – particularly for MRIs, fiber optics, semiconductor manufacturing, and other electronics manufacturing. The United States is currently the world's largest producer of helium. In 2019, the United States generated 68 million cubic meters, Qatar produced 51 million, Algeria produced 14 million, Australia and Russia, the next largest producers, produced 4 and 2 million cubic meters, respectively.

The world is poised to meet this demand. Qatar has two production facilities and has become the largest exporter and the second-largest producer of helium gas in the world. One facility is the largest helium processing facility globally, with a daily production capacity of 17.3 million tons of liquid helium. Qatar's North Dome gas field accounts for more than 28% of the world's helium gas reserves; followed by Iran (which shares the field), Russia, and the United States. By the close of 2021, Qatar will reach nearly 35% of global helium production, with a total production capacity of 2.6 billion cubic feet per year.

Gazprom's new facility in Siberia will increase Russia's share in the global helium market to 25-30% of global helium demand within a few years. And, in North America, Avanti Energy acquired license production on 8500 acres in Alberta and 62K acres in Montana.

The estimated value of Grade-A helium (99.997% or greater) extracted during 2020 by private industry was about $322M. Fourteen US plants (Arizona -1, Colorado - 2, Kansas - 5, Oklahoma - 1, Texas -4, and Utah - 1) produced crude helium that ranged from 50% to 99% purity. In 2019, estimated domestic consumption of Grade-A helium was 40 million cubic meters (1.4 billion cubic feet), and it was used for magnetic resonance imaging (30%); lifting gas (17%); analytical and laboratory applications (14%); welding (9%); engineering and scientific applications (6%); leak detection and semiconductor manufacturing (5% each); and other minor applications (14%). Medical use includes breathing mixtures to help reduce density (asthma, emphysema). A mixture of 80% helium and 20% oxygen is used as an artificial atmosphere for deep-sea divers and others working under pressurized conditions.



Pay $125K to fly into the Stratosphere in a Hydrogen Balloon?

It's like a bad "Fact or Crap" question.

And, yes, you may reserve a seat on the Spaceship Neptune for $125K, courtesy of Space Perspective, space flight company, which is proposing this idea. The six hour flight goes 100K feet up (1/3 of the way to outer space), high enough to see the curvature of the Earth. A football field sized balloon tows a 16 foot wide capsule with 9 seats (8 passengers and a pilot), bathroom, bar, Wi-Fi, communications devices to allow live streaming, and a splashdown cone at base for landing. Touted as a "radically gentle voyage", the airship travels at 12mph, two hours to reach cruising level, drift for hours and descend to land in the Atlantic Ocean. A recovery ship will pick up the passengers from there.

Husband and wife CEOs, Taber MacCallum and Jane Poynter, founded Space Perspective in 2019 with the mission to make spaceflight more accessible. Spaceflights for 2024 are booked; reservations are available for 2025. Both CEOs founded World View Enterprises, Inc., space exploration company in 2012; one of the company's high-altitude balloons exploded in Arizona during a 2017 fuel fill test. The company reportedly was able to use helium or hydrogen in its balloons but the company would not say which was used during the explosion. Video showed gas going up in flames, indicating hydrogen use. Two employees were treated for ringing in the ears, the boom shook up residents in the area, and the explosion caused some facility damage, but was otherwise uneventful.

MacCallum said that helium has become difficult to obtain, resulting in the decision to use hydrogen. The company insists, "Hydrogen is the gas of choice of balloonists around the world. There have been no recorded gas balloon flight failures caused by hydrogen going all the way back to the earliest flights in the 1700s." Hot air balloons today use hydrogen or helium for liftoff but use burning liquid propane to maintain the flight. Airships use helium, not hydrogen…

So, let's talk about the Hindenburg. The good news from that disaster is that the number of survivors was higher than the number of victims – of the 97 passengers and crew, 62 survived. Hugo Eckener, the Hindenburg designer, wanted to use helium instead of hydrogen but the US had a monopoly on the world supply and did not want other countries using helium for military uses. The Hindenberg was filled with 7M cubic feet of hydrogen gas and (nope not kidding) included a smoking room. Passengers could buy cigarettes and Cuban cigars on board and smoke in that room. The room had a double-door airlock and was pressurized to prevent hydrogen from getting in. Joseph Goebbels, Nazi propaganda minister, pushed to have the airship named after Hitler, but Eckener named it after the late German president Paul von Hindenburg. Most ships took 5-10 days to cross the Atlantic ocean, but the Hindenburg could make the trip in 2 ½ days, and crossed 34 times before the accident.

The Hindenburg disaster was caused by electrostatic discharge – a spark ignited leaking hydrogen. Eckener had a perfect safety record prior to this flight, with no passenger ever sustaining serious injury in over 1M air miles of flight. He believed the leak was caused by the airship taking a sharp turn which overstrained a bracing wire, causing it to snap and rip open an adjacent gas cell. The airship was 60 meters above the airfield and the accident was captured on film. There had been numerous similar accidents prior to this one, with more casualties, but in remote areas with little media attention. The disturbing sight of the burning airship putting an end to this approach to passenger flight (at that time).

Data Supernova

The data explosion is staggering, with exponential increases expected…

Every day… people watch 5B videos on YouTube, send over 306B emails, 500M tweets are posted on Twitter, 18.7B text messages, over 3.5B searches on Google, and 4 petabytes of new data is generated by Facebook (around 400 users sign up for Facebook each minute).

Google, Facebook, Microsoft, and Amazon store 1200+ petabytes of information. By 2025, the amount of data generated each day will reach 463 exabytes (1 exabyte = 1000 bytes to the sixth power).

At the beginning of 2020, the number of bytes in the digital universe was 40x bigger than the number of stars in the observable universe. And, 90% of data in the world was produced in the last few years.

Data Storage, Servers, and Data Center Infrastructure in Space

Data storage is moving from the ground to the cloud to outer space. The exponential growth in data supports increased capacity and technological advances for each. Currently, the focus is on satellites. In 2020 1,283 satellites were launched, the highest number of satellite launches in a year. This year, more than 850 satellites have already been launched. The growth in the number of satellites over the last decade was mainly driven by the development of the smaller CubeSat, which allows a large number of small sized satellites to launch at the same time, earlier rockets were used only to launch one or two satellites at a time. SpaceX launched 172 Starlink satellites in just three launches.

Google has partnered with SpaceX to use the Elon Musk's space company's satellite internet service, Starlink. SpaceX will install Starlink terminals at Google's cloud data centers around the world. Starlink customers can use the cloud and Google can use the internet serve for its enterprise cloud customers. SpaceX has launched 1,625 Starlink satellites, with about 1,550 currently in orbit. Amazon plans to launch 3000 satellites into the same orbit as Starlink, also to provide internet service and leverage internet connectivity from the Kuiper project to supercharge its AWS cloud services.

Cloud Constellation has a network of 10 low earth orbit satellites, Spacebelt, for space-based secure cloud data storage and will launch an entire data center into space by the end of the year using a network of small satellites, each with 1 petabyte of data storage. IBM plans to store their AI systems, Watson, on Cloud Constellation satellites.

Datacenters on the ground, which store info in the cloud, are among the largest consumers of energy. However, Viasat, a company headquartered in Carlsbad, CA, challenged expansion of Starlink based on environmental grounds and arguing for review of $900M in rural broadband subsidiaries granted to Starlink, saying they were not even granted the opportunity to apply. So far, all of their legal maneuvers have been denied, during which time, SpaceX has continued to launch satellites. SpaceX says they are working with astronomers to minimize any light pollution impacts. Each satellite is about as a big as an office desk and weighs 500 pounds (photo).

LyteLoop Technologies recently raised $40M to make a space-based data storage center. They will launch 6 proof-of-concept satellites in the next 3 years and plan to offer live data storage service in 5 years. They see the benefit of scalability as a prime driver for this approach because they use angle multiplexing (by creating more paths for light to travel, they can add more storage capacity).

> *"We are a storage company. We are storing data in a different medium – on photons – and in our case, in space. The essence is that we have communications links and photons going back and forth. That back and forth is the storage medium."*
>
> Ohad Harlev, Chief Education Officer, Lyteloop Technologies

According to the Index of Objects Launched into Outer Space, maintained by the United Nations Office for Outer Space Affairs, there were 7,389 individual satellites in space at the end of April, 2021. 11,139 satellites have been launched, out of which only 7,389 are in the space, while the rest have either been burnt up in the atmosphere or have returned to Earth in the form of debris.

> *"Building a shoebox-sized satellite can cost between $100,000 and $300,000. It costs about as much to launch an app as it does to make and launch a satellite."*
>
> Sunil Nagaraj, Founding Partner of Ubiquity Ventures
>
> His former firm invested over $50M in three space companies — Skybox, Rocket Lab, and small satellite maker Spire.

Edge Computing/Storage – Get (and Keep) Your Data Off of My Cloud

with sponsors Lightbits Labs, ScaleFlux, and NGD Systems

How big of a problem will edge data be for your organization over the next five years? (select one):

It is already a critical concern for our organization:	3%
We expect it to be critical problem w/in next 5 yrs:	18%
We expect it to be one of our significant data probs w/in next 5 yrs:	26%
It is a concern, but not one of our high priorities w/in next 5 yrs:	9%
It is not a concern for us within the next 5 years:	9%
Unknown how much of a problem it will be for us:	35%

For those of you who believe that edge data will be an issue for your organization, what options are you looking at? (select all that apply):

Pre-processing of data as it is ingested at the edge:	31%
Sampling the data and transmitting samples only:	15%
Data compression approaches:	27%
In-situ processing of the data at the edge:	35%
New networking techniques/capabilities:	27%
A combination of these approaches:	50%
Other:	8%

G2M Research Multi-Vendor Webinar Series

Our webinar, Tuesday, August 17, "AI/ML Storage – Distributed vs Centralized Architectures", sponsored by Weka, AIC, and Excelero, is available to view. Register for our webinars and we will send these recordings directly to you.

View the recording here and/or download a PDF of the slides.

Our webinar schedule is below- Click on any of the topics to get more information about that specific webinar. Interested in sponsoring a webinar? Contact **G2M** for a prospectus.

We also host custom webinars and webinar series as another highly effective approach to reach your target audience – before the webinar(s) with direct and social media marketing, during the webinar with a customized presentation and audience polls, and after the webinar with use of the recording and presentation materials for outreach.

You can view all our webinars and access all the slide deck presentations.

Sept 14:	Cybersecurity: Measuring (and Countering) Third Party Risk
Oct 12:	Cloud Service Providers: Is Public Cloud, Private Datacenter, or a Hybrid Model Right for You?
Nov 9:	The Radiometry Data Explosion: Can Storage Keep Pace?
Dec 14:	2021 Enterprise Storage Wrap-up Panel Discussion

Enterprise Storage Events

September 20-22	Bio-IT World, Boston
September 28-29	SDC21, Virtual
October 5-7	VMworld, Virtual
October 6-7	Digital Transformation Expo Europe, London
October 6-7	P99 Conf, Virtual
October 11-13	NAB, Las Vegas
October 20-22	NetApp Insight, Virtual