In the Hall of the Mountain Data King

IBM takes data protection to a new level, 150 meters underground at the Lefdal Mine Datacenter in Norway

Deep underneath Norway's craggy northwest coast, through tunnels hollowed out by miners decades ago, preparations are under way to transform a man-made mountain hall into a massive datacenter. At a planned 200 megawatts, Lefdal Mine Datacenter has the potential to become the largest in Europe.

It may also be one of the greenest on the planet, powered by renewable energy and cooled by water from a fjord just south of the mine. And it will be one of the most resilient as well. What could be more secure than sheltering servers under more than a hundred meters of rock? The high-density rock provides natural protection from electromagnetic disruptions, and the single point of entry is concealed in the mountain and secured by a series of steel doors.

Resilience is built in to the technical development of the Tier III datacenter as well. IBM is the technology partner for Lefdal Mine Datacenter, developing the technical design and providing an independent quality assurance for the entire blueprint from the beginning. IBM will also offer clients resiliency services for data and server protection from within the mine once the facility goes live in August 2016.

Lefdal Mine Datacenter

- Powered by abundant, cost-effective green energy

- Underground facilities impervious to an electromagnetic pulse, such as a lightning strike or electronic sabotage, and other disruptions

- Leading technology from IBM and Rittal

- Site and facilities strategy and design services

- Cloud-based Resiliency services

"The Lefdal Mine facility will provide a unique opportunity for clients looking to enhance levels of resiliency within their organization through the provision of an out-of-region recovery solution that is highly scalable and powered by 100% renewable and fully redundant energy sources," says Arne Norheim, country general manager of IBM, Norway.

This is where the industrial age meets the digital age—and where the cloud goes underground.

The Mine: where the industrial age meets the digital age and where the cloud goes underground

The mine was once a source for olivine, a dense mineral used in casting aluminum and steel because of its high melting point. But the mine has sat empty and nearly invisible for the last few decades. For Lefdal's owners—a group of local residents and farmers who own the land above the mine—it was hard to visualize what to do with all that underground space. The idea came about seven years ago when the mine's former CEO was on a hike: why not take advantage of the natural security of the existing structure, as well as Norway's cool climate and surplus hydropower, to create a green IT environment for the 21st century? This is recycling, reusing and reimagining on a very grand scale.

Representatives from the mine approached IBM to test the idea, and IBM executives in Europe recognized the datacenter plan as a once-in-a-lifetime opportunity, says Brian Farr, director of resiliency services for Europe, IBM Global Technology Services. So did the local utility, which is now a 16% owner of the datacenter. Friedhelm Loh, a privately held German industrial group, owns 33.3%, and Maloy Investors, a consortium of local companies, holds 50.7%.

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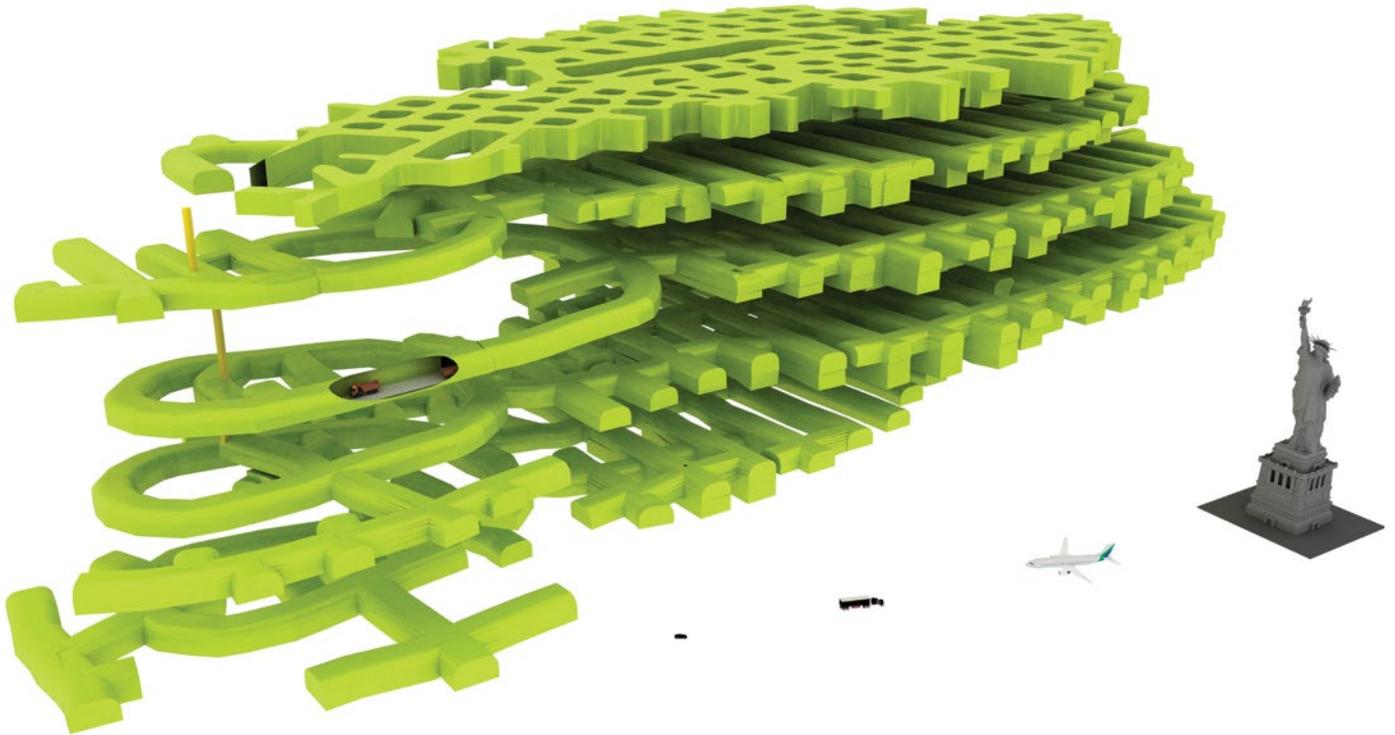
The mine is massive, with 120,000 square meters of potential white space spread over multiple levels.
Watch video of the Lefdal Mine Datacenter https://www.youtube.com/watch?v=oN9on73BmSsv

Construction is already well under way at the mine, though it's hard to see from the outside. The entrance to the mine is almost hidden from the two-lane mountain access road. It looks like the arched opening to a natural cave—except for the giant steel door and security features.

Even from the inside, it's hard to imagine how massive the mine is. Picture a spiral road, gradually descending 150 meters through the rock. The spiral is 14 meters wide—wide enough for two tractor-trailers to pass easily—and connects to boulevards running across six levels. Radiating off the boulevard are streets running through the chambers that will hold the servers.

The chambers are where the servers will live, stacked on top of one another in containers. The 75 chambers in the mine are 11 meters to 18 meters high, giving them the feel of a cathedral. Each will be able to hold multiple containers, two on either side of the road and stacked three or four high, connected within each chamber by a series of walkways and stairways. Using server and power modules, housed in standard shipping containers, will allow for quick installation in

the mine and easy placement and movement.

Above ground, a reception area and an office building are under construction. Datacenter clients will have access to designated office space, meeting and staging rooms, secure storage areas for deliveries and nearby accommodation facilities. Existing fiber rings connect the mine to Europe and to Asia through northern Russia. Fiber also runs near Lefdal, across Iceland to North America.

The green solution

It's easy to see why clean, reliable energy is a powerful draw for datacenter tenants. Datacenters can use as much power as a small city, and they can be very expensive to cool. If the datacenter industry were a country, it would be the 11th-largest electricity consumer in the world, according to a study by Chris Drake, research director at DCD Intelligence, a research firm based in the United Kingdom. Datacenters burned 375TWh in 2013, compared with 360TWh for all of the UK. Half of the energy consumed by the average datacenter is used to meet cooling requirements.

Being underground will help with temperature regulation. The mine is a constant 8°C year round, no matter what is happening above ground. The mine's location at the edge of a fjord means water can be piped through to provide natural cooling. The water in the fjord is a frosty 7.5°C year round. The mine is partly below sea level, eliminating the need for expensive high-capacity pumps to move the seawater through the cooling system's heat exchangers. As a result, the mine will have a PUE (power usage effectiveness) of under 1.1, meaning almost all power will go to the equipment, with very little power needed for the facility overhead. An IBM-commissioned study by CH2M, the American engineering company, concluded that the mine's cooling system will be a 20% to 30% improvement over current leading-edge design in Europe.

Lefdal will be supplied by 360MW of hydroelectric and wind power, provided initially by four hydroelectric power plants nearby. "The power plants can take a sea cable and run it straight into the mine without ever having the power production or the cabling above the ground," explains Mats Andersson, chief marketing officer for Lefdal Mine Datacenter. This minimizes the possibility that the power supply will ever be affected by a natural disaster. In two years, Lefdal plans to build a transformer station inside the mine that will be directly fed by two hydropower plants in the mountain, further reducing costs, says Anderson.

The datacenter also has the blessing of Oslo, where the government is looking for ways to export Norway's surplus energy. Officials are concerned that Norwegian electricity prices—already among the lowest on the continent—could continue to fall as the supply of hydro and wind power increases. Rather than distributing power across Europe, Norway is trying to attract heavy power users to locate near green energy sources. Building datacenters on Norwegian soil is one way to do that. As an added incentive, the government announced a reduction in taxes on electricity for industrial datacenters in the 2016 budget.

At the same time, Norway's low-cost green energy is a draw for companies in Europe who are trying to move away from nuclear power and decrease greenhouse gases from burning carbon fuels as well as reduce the need for imported oil and coal. There is a push among European companies to move low-labor, energy-intensive workloads to a greener alternative.

The industrialization of the datacenter

Datacenter capacity is growing fast, but so is demand. According to IDC estimates, the amount of new enterprise data doubles every 18 months—less time than it takes to construct a new brick-and-mortar datacenter. Then there is the inevitable obsolescence of server technology; the average datacenter is outdated in less than 10 years. At the same time, new regulations in many areas require remote backup. All of these factors are driving demand for outsourcing and co-location, giving rise to the industrial datacenter.

In the face of torrid demand growth and the need for speed, Lefdal showcases the advantages of a modular approach to datacenter development by providing a ready-made, self-contained datacenter in a box. A modular datacenter offers nearly everything a traditional brick-and-mortar datacenter does, except construction delays, cost overruns, onsite construction mess and excess space.

Datacenter white space continues to increase, especially outsourced space

Source: DCD Intelligence
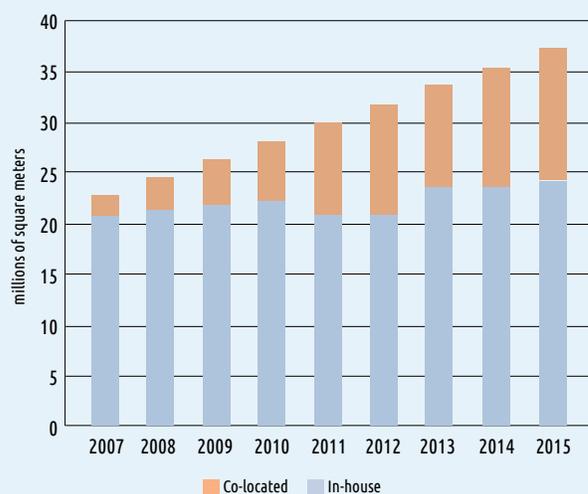
"Most organizations think they need customized solutions, but that can take a lot of investment," explains Andreas Keiger, executive vice president for European sales at Rittal, a market leader in IT infrastructure and part of the Friedhelm Loh Group, a major investor in Lefdal Mine Datacenter and an infrastructure partner with IBM.

Rittal has developed server and power modules specifically for the Lefdal facility that can be equipped and installed in only six weeks. The modules will be manufactured in Germa-

Q&A

With Brian Farr, Director, Resiliency Services for Europe at IBM Global Technology Services

An abandoned mine is an unusual site for a datacenter. How did IBM determine feasibility?

Yes, it is unusual, but it ties in with other initiatives at IBM around smart cities and making productive use of something that was previously redundant, as well as supporting local enterprise investments, creating graduate-level jobs within IT and high-tech industries within the local and national economy. We looked at several different locations where we could bring an innovative approach to datacenter design leveraging green renewable energy. Lefdal stood out for us because of the sheer scale and potential of the site.

The mine's proximity to the fjord really tested our engineering teams, but it also gave them a chance to do something truly innovative. We were able to draw on our experience working in other unusual locations over the years, such as disused underground bunkers in Switzerland and mainland Europe. Our plant and facilities engineering teams have extensive experience on datacenter design, bringing deep mechanical and electrical engineering expertise to create solutions in environments even more challenging than the Norwegian mountains. We were also able to draw on our unique ecosystem of alliance partners to support the design and plan to build and run what will become a truly world-class managed facility.

How important is the modular system for fast delivery of high capacity at Lefdal Mine Datacenter?

There is a history of using the modular approach at remote locations such as oil and gas rigs, along with heavy industry and manufacturing plant locations, where building a traditional brick-and-mortar datacenter is not a feasible option. But it also makes sense for any client that has outgrown its existing datacenter capacity, where it is leasing space within expensive metropolitan locations or when the cost of retrofitting its own datacenters is capital intensive and prohibitive.

Traditionally, clients have solved capacity constraints by either migrating into new facilities or investing in significant virtualization to free up capacity. This creates uncertainty and increases risk within the IT operation without creating value for the enterprise. Our approach at Lefdal Mine Datacenter offers the ability to reduce risk and enhance resiliency by adding capacity on a modular basis in a very simple way without significant real estate, infrastructure or construction costs.

What is the appeal of Lefdal Mine Datacenter for potential tenants?

For any datacenter construction, there are two common limiting factors: physical real estate and power capacity. This is one location where those two limiting factors disappear. It is hard to describe the scale of this facility. On the third level alone, where we are starting the buildout, we can house what would be thousands of virtual datacenters that can scale flexibly, providing the perfect location to deliver hybrid IT, private and public cloud services for enterprises across Europe.

Another big factor is the resiliency of the mine itself. Resilient enterprise IT begins with resilient datacenters. The Lefdal Mine Datacenter is the perfect solution for clients looking to remove the shackles of real estate, reduce their carbon footprint, benefit from lower energy prices and accelerate the shift of their own IT to a far more resilient and flexible operating model, one that is designed for the always-on enterprise.

ny, assembled in shipping containers, pre-certified, tested and ready to plug into the cooling and power infrastructure at the mine. The containers can even be shipped to a customer's premises first, where they can install their own equipment if they wish, before being placed in the mine.

The modules are extremely scalable, with their plug-and-play capacity. Tenants can also rent a room in the mine, build out their own datacenters and make their own arrangements for management, if they prefer. The size and logistics of the mine mean tenants will be able to reserve space for future growth with limited initial investment, knowing the infrastructure, the technology and the most up-to-date resiliency will be there when they need it.

"We are going to continue to build out for the next 10 years," says Andersson. "IBM, with its history of building more than a thousand datacenters over the last 10 years, has been fundamental to establishing Lefdal," he adds. "And IBM will be part of our offered resiliency services from day one.

"But we also need to continue to stay ahead of the technology going forward," he says. "The people at IBM have a futuristic sense of where we will be a few years from now. Having them manage the technology program at Lefdal is a big part of our conversations with potential partners and clients."

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