Energy Saving Practice

Especially during the pandemic, the increase in energy costs posed a problem for radiology practices and clinics. In this interview, Prof. Martin Klein tells us why he started looking into the use of alternative energy sources more than ten years ago.

"As a radiologist, you deal intensively with technology. radiology is both a craft and applied physics. And that is a good thing!"

Prof. Hans Martin Klein

By Mélisande Rouger

Prof. Klein, in Germany you have recently become the man to watch when it comes to reducing energy costs in radiology. How did this come about?

In 2010, I built a medical center on the high Westerwald, where the wind is known to be so cold. The Energy Saving Ordinance (EnEV), which was still quite new at the time and came into force in 2009, favored the use of alternative heat sources. At the time, I thought that somehow the MRI scanner could be used as an alternative energy source, because the system produces about 20 kW of waste heat 24 hours a day, seven days a week. In addition, the energy needed to cool the MRT could be saved. This concept also reduced the requirements for the building structure, which saved additional costs.

These measures enabled us to save about 85 percent of our heating costs. We were surprised by this ourselves at the time.

Can such heat exchangers be installed in any practice or was this something practice specific?

The waste heat from the superconducting MRIs is not something practice-specific. The problem with this interface, however, is that not all practice owners own the practice space, because the conversions have to be coordinated with the building heating system.

Surely there are additional potential savings in radiology?

After the medical center was built, I started planning an energy-optimized practice with an open MRI. Knowing how little energy low-field MRIs require, we went with a 0.35 Tesla system in 2019.

Another aspect of conservation or sustainability in radiology is, of course, helium. There is only one source for helium right now, and it's in Poland. In addition, helium is slowly becoming scarce. Superconducting MRIs require up to 2,000 liters of the gas, which is in liquid form at around −270 °C, to cool the system.

In addition, some evaporates regularly and must be refilled. New MRI scanners get by with significantly less than 10 liters of helium. The system with the lowest consumption is even only 0.7 l at a field strength of 0.55 Tesla.

Are there noticeable differences in image quality between a 0.55 Tesla low-field and a superconducting 1.5 Tesla MRI?

The image quality of MRI scanners is something like this: if you double the measurement time, you get roughly identical image quality at half the field strength.

In addition to the field strength, the homogeneity of the system and the gradients also play an important role in image quality. Furthermore, it is a question of how the K-space is sampled. Compressed sensing is one of the buzzwords here – along with matrix coils or concepts such as SMS. Modern low-field MRI with permanent magnets already use these techniques. Doubling the coil elements has the same effect as doubling the field strength.

Images from low-field systems are surprisingly good. In addition, there are specific advantages of lower field strengths such as less metal artifacts, better T1 contrast, better phase separation in Dixon sequences, less dielectric effects, less impact on implants such as VP shunts or cochlear implants. In the past, low-field systems were always a bit frowned upon, but currently they are experiencing a small renaissance.

With the energy-optimized low-field MRI practice, Prof. Hans-Martin Klein pursues the idea that economy, ecology and gentle medicine are congruent principles. Since November 2022 a new open MRI is in operation. More image quality, more comfort, even less energy consumption!

To what extent does artificial intelligence play a role in the image quality of MRIs?

Image quality is essentially about the signal-to-noise ratio. So you can either increase the signal by putting more power into the field strength and the gradients, the coils and so on, or we can try to reduce the noise.

If you reduce noise with classical felting, the images always lose information. Deep learning reconstruction, on the other hand, is able to reduce noise without losing information by preserving contour information. Of course, this can only be used within certain limits, because otherwise one runs the risk of pretending an accuracy that is not there at all. But compared to the filters that were available in the past, we now have very powerful AI algorithms at our disposal. This will bring significant advantages for low-field systems.

https://www.greenscan-imaging.de/

A new approach to the Improvement of Energy Efficiency in Radiology Practices, Prof. Hans-Martin Klein, Thieme Verlag, https://www.thieme-connect.com/products/ejournals/abstract/10.1055/a-1123-7944