Addressing the energy crisis in healthcare

siemens-healthineers.com/insights-series

The world is facing an energy crisis, and healthcare is inevitably impacted, while services and providing patients with access to care must be maintained.[1, 2, 3, 4] Hospitals can consume up to 2% of a country's total energy consumption. And energy costs are rising, even though utilities contribute to only 3% of total hospital costs, there is a clear financial impact.[5] For example, at the Universitair Ziekenhuis in Brussels, their gas and electricity bill has doubled in two years, to a projected € 6 million this year.

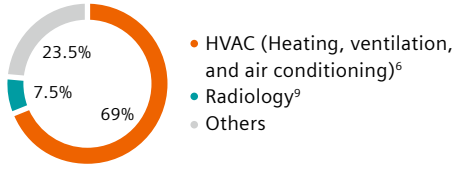
The EU and its member states are taking various actions to reduce the impact of this energy crisis, and to safeguard the resilience of medical technology supply chains. However, every institution and individual can help to tackle this crisis.

Responding to the current energy crisis demands a range of actions: identifying energy waste and overconsumption; upgrading infrastructure including power generation and storage capacity; reducing unneeded services; finding ways to lower overall energy demand; and investing in more efficient equipment. Many hospitals can also explore renewable energy options, e.g., solar or wind.

How is energy consumption distributed within hospitals?

Energy is consumed 24/7, about 8,800 hours per year in a hospital setting. The major energy consumption factors in a hospital are heating, ventilation, air conditioning (HVAC) and lighting. Consumption is in general similar although it has geographically specific variations. For example, in the U.S. these factors account for 69%,[6] in Spain 62%,[7] and in China 55% of total energy consumption in hospitals.[8]

The major energy consumption factor in a hospital is HVAC



Note: Specific data for medical equipment in radiotherapy and laboratory diagnostics department is often considered outside of radiology departments.

Immediate actions that can be taken to reduce energy use in a hospital include:

1. Make transparent and measure energy consumption on a system and department level, making energy consumption a KPI. Consequently, reflect internal costs for elevated energy consumption to departments, and reward with incentives for lower energy consumption.

2. Smartly control air exchange and lighting, for example, with an enterprise-wide reduction of artificial air exchange when not necessary (no procedures, unoccupied rooms with automation) or proactive use of natural air exchange and natural lighting where possible.

3. In facilities where artificial heating is needed, lower ambient temperature by 2–3 degrees especially in spaces where patients' wellbeing is not compromised (storage areas, etc.).[10] Where air conditioning is used, use interior design and construction materials to keep the room temperature naturally cooler.

Long-term, on the other hand, with renewable energy sources such as wind and solar, procuring renewable energy is becoming increasingly effective and practical and has been implemented by many hospitals and clinics around the globe.[11]

SIEMENS Healthineers

Where are the opportunities to reduce energy consumption in radiology, radiotherapy, and clinical diagnostics laboratories?

While medical devices are not the top contributors to energy consumption in a hospital, they consume as much as 7.5% of total energy. For freestanding centers imaging equipment alone can represent up to 19% of energy costs.[12] In addition, old medical devices may potentially consume more energy and water than modern equipment, under the same performance.

A Swiss study from 2018 found that annual energy consumption of four MRIs and three CTs amounted to 4% of a hospital's energy usage and was equal to the energy consumption of a town of 850 people.[13] Studies have shown that two-thirds of energy consumption for CT scanners takes place while in a nonproductive, idle system state. For MRI systems, one-third of energy consumption is attributed to idle state due to helium cooling operation.[13] Similarly, diagnostics laboratories consume less energy than other hospital departments. Nonetheless, the diagnostics lab can still contribute significantly to reducing a facility's energy and water use and improving its overall sustainability. Departments with linear accelerators and radiotherapy devices are also of major importance due to their more continuous power draw, for example, in a U.K. hospital, one radiotherapy bunker providing 500 treatments per month consumed ~4,500 kWh per month.[14]

COCIR, the European Coordination Committee of the Radiological, Electromedical and Healthcare IT Industry, has developed methodologies for measuring energy consumption and recommended efficient use of medical devices.[12] In addition, solutions like teamplay insights can provide better transparency about idle times of the systems and thus potential for energy saving. **Specifically, to lower energy consumption in departments with medical equipment, e.g., radiology, clinical diagnostics laboratories and radiotherapy, immediate efforts should be focused on these three areas:**

Up to 19%

of enery costs in freestanding centers come from imaging equipment

9.5 kWh

potential saving in CT per day through System Off state

13%

potential saving in MRI through Eco Power Mode during idle time

1 Shorten idle time between use

a) Gain transparency of system usage and identify non-productive idle times.

b) Conduct **workflow simulation** to optimize planning and maximize utilization of medical equipment in radiology, radiotherapy, and laboratory.

c) Implement **workflow improvements,** such as using a second patient table to set up the next patient outside the room to reduce idle time between equipment use.

2 Reduce energy during inevitable idle time

a) Enforce **standby mode** during idle time; for example, **Eco Power Mode** has a potential saving of 13% energy in MRI, and **Auto Comp On** (sleep mode) feature in CT can save up to 56% energy.

b) Upgrade to more energy efficient technology or technology which uses standby mode automatically, for example, through software upgrades.

c) Use automatic time switch in MRI system to program start-up and shut-down time to avoid high energy consumption while the system is not in use during the night.

d) Disconnect CT systems from the main power supply with wall switch to avoid energy consumption in System Off state. It results in additional potential energy saving of 16% per day.

3 Reduce energy consumption while operating

a) Shorten exam duration by **utilizing latest accelerated data acquisition** or AI-powered deep learning reconstruction methods such as Deep Resolve for MRI, which can reduce scan time and equally energy consumption per patient by as much as 60%.

b) Employ **workflow enhancement tools** in imaging, laboratory, or therapy, such as myExam Companion or FAST workflow on MRI or CT scanners to shorten exams while maintaining high level of diagnostic quality.

For further information and activation, please contact your local Siemens Healthineers and Varian service technician.

Case study in hospital modernization[15]

Since it opened in 1976, Klinikum Bremerhaven has been the most modern hospital of its kind in the Bremen region, with a total of 710 beds. However, the building's technical facilities and systems needed to be modernized. In 2004, the hospital's primary energy costs were € 2.4 million.

Siemens Smart Infrastructure was awarded the contract for energy-efficient renovation with a project duration of 12 years. A total of 120 individual measures were subsequently implemented, including improvements in heating, ventilation, air conditioning, electrical engineering, compressed air technology, steam supply, kitchen appliances, sterilization, and other maintenance and operations management. With these measures, Klinikum Bremerhaven was able to save € 12.5 million (>40% saving) over the project duration.

Case study in radiology[16]

Siemens Healthineers and the University of California San Francisco (UCSF) have formed a research and innovation-driven collaboration to make radiological imaging greener. The first key area of innovation, Green Radiology, will include the creation of a first-in-the-world carbon-neutral radiology imaging service at UCSF. Power consumption of radiology equipment at UCSF is monitored using Siemens Smart Infrastructure solutions. The collaboration will also leverage new Siemens scanner technology that is greener, lighter, smaller, and has easier siting requirements, so that more patients can access high-quality imaging without traveling long distances, and at the same time will explore ways to reduce standby energy consumption of MR scanners. Outcomes of this collaboration will guide future developments and applicability for other healthcare providers.

Case study in clinical diagnostics laboratories

The Atellica Solution chemistry analyzer, which can produce up to 1800 patient results per hour, has a maximal energy consumption of 1.9 kW,[17] which is only 0.0010 kWh per patient result. Among other energy-saving features, the analyzer reduces energy consumption by automatically switching to standby mode when not loaded with sample tubes.

Water supply and processing, a need for laboratory equipment, is also one of the biggest energy consumers worldwide. By replacing existing equipment with an innovative Siemens Healthineers solution,[18] a private reference lab reduced water consumption by 32% which had a direct impact to energy savings and significant reduction in CO_2 emissions.

Case study in radiotherapy[14]

In radiotherapy, similar aspects as in radiology apply. At NHS Hull University in the UK, the linear accelerator (Linac) was replaced last year with a new system which allowed therapeutic radiographers to treat around 20% more patients each month, while power consumption dropped by 70%. Peter Colley, Consultant Physicist and the Trust's Lead for Radiotherapy Physics, says: "The reduction in energy we're able to record doesn't include the air handling and the chiller plant on the building roof which offsets the heat generated by the radiotherapy treatment machines. These aren't metered independently, but it stands to reason that if we are putting that much less power in, we're going to be taking proportionately less heat out into the sky, while also cooling less."

In summary: Checklist of actions to reduce energy consumption today

- [ ] Gain transparency of energy consumption in the institution and non-productive system idle time
- [ ] Efficient temperature control – lower ambient temperature by 2–3 degrees
- [ ] Smart ventilation – automatic ventilation adjustment depending on occupancy
- [ ] Efficient lighting – use LED lighting and automatic switch-off
- [ ] Ensure systems are shut down when possible, or in power-saving mode when idle in operating hours.
- [ ] Responsible exam and scan protocol decisions to optimize the use of medical equipment
- [ ] Update medical equipment to the most efficient version
- [ ] Utilize newest IT solutions to streamline and shorten lab processes to use less energy per patient result

What can be done towards the future:

- [ ] Build hospital energy resiliency with local energy storage solutions
- [ ] Use energy simulation software and data centers for energy optimization
- [ ] Procure clean energy and produce green energy onsite

References

1. Could the energy crisis cause a public health emergency? [cited 19.08.2022] Available from: **nhsconfed.org/longreads/could-energy-crisis-causepublic-health-emergency**

2. The Costs of Rising Energy Prices – How the Energy Crisis will Impact the Health and Social Care Sector [cited 19.08.2022]. Available from: **ridout-law.com/how-the-energy-crisis-will-impact-the-health-and-socialcare-sector/?utm_source=rss&utm_medium=rss&utm_campaign=howthe-energy-crisis-will-impact-thehealth-and-social-care-sector**

3. The energy crisis puts a health timebomb under Britain's most vulnerable [cited 19.08.2022]. Available from: **ft.com/content/bbb4ee56-f846-4aa3-8233-c28924890fee**

4. German government pledges energy cost support to hospitals [cited 04.10.2022]. Available from: **cleanenergywire.org/news/germangovernment-pledges-energy-costsupport-hospitals**

5. 2021 cost of caring: AHA [Internet]. American Hospital Association. [cited 10.11.2022]. Available from: **aha.org/guidesreports/2021-10-25-2021-cost-caring**

6. Bawaneh, K. et al. (2019). Energy Consumption Analysis and Characterization of Healthcare Facilities in the United States.

7. Etkho. Current outlook of hospital energy cost and consumption [Internet]. ETKHO Hospital Engineering. 2022 [cited 10.11.2022]. Available from: **etkho.com/en/current-outlook-of-hospital-energy-cost-and-consumption**

8. Shen, C. et al. (2018). Analysis of building energy consumption in a hospital in the hot summer and cold winter area.

9. Aunión-Villa, J., Gómez-Chaparro, M., García-Sanz-Calcedo, J. Study of the energy intensity by built areas in a medium-sized spanish hospital. Energy Efficiency. 2021; 14 (3).

10. Temperature management. Clinical Guidelines (Nursing) [cited 8.11.2022]. Available from: **rch.org.au/rchcpg/hospital_clinical_guideline_index/Temperature_management**

11. Practice Greenhealth Energy [cited 8.11.2022]. Available from: **practicegreenhealth.org/topics/energy/energy**

12. COCIR. Guidelines on energy savings [cited 8.11.2022]. Available from: **cocir.org/fileadmin/6_Initiatives_SRI/GoodEnvPractice/COCIR_CT_guidelinesforgoodenvironmentalpractive_19-05-14.pdf**

13. Heye, T. et al. (2020). The Energy Consumption of Radiology: Energy and Cost-saving Opportunities for CT and MRI Operation [cited 8.11.2022]. Available from: **pubs.rsna.org/doi/full/10.1148/radiol.2020192084**

14. NHS Hull University Teaching Hospitals (2022). Halcyon saves energy and saves lives [cited 8.11.2022]. Available from: **hey.nhs.uk/news/2022/01/26/halcyon-saves-energy-and-saves-lives**

15. 'Energetic treatment' for Klinikum Bremerhaven [Internet]. Wilo Corporate [cited 10.11.2022]. Available from: **wilo.com/il/en/Solutions/Global-references/References-details_1793.html**

16. Siemens Healthineers and UCSF Create First Carbon-neutral Radiology Imaging Service [Internet]. UC San Francisco. 2022 [cited 10.11.2022]. Available from: **ucsf.edu/news/2021/11/421756/siemens-healthineers-and-ucsf-create-first-carbon-neutral-radiology-imaging**

17. Atellica® CH 930 Analyzer Environmental Product Declaration (12013 04-2022). Published by Siemens Healthcare GmbH.

18. Siemens Healthineers Automation and IT Solution vs. the previous system configuration from Roche Diagnostics, Abbott Diagnostics, and Beckman Coulter Diagnostics.

Siemens Healthineers Headquarters
Siemens Healthcare GmbH
Henkestr. 127
91052 Erlangen, Germany
Phone: +49 9131 84-0
siemens-healthineers.com

Contact:

For further information on this topic, or to contact the authors directly:

Joanne Grau
Global Thought Leadership Manager
joanne.grau@siemens-healthineers.com

Isabel Nieto Alvarez
Global Senior Key Expert for improving patient experience
isabel.nieto@siemens-healthineers.com

Vibhas Deshpande
Senior Director,
MR Research and Development Collaborations
vibhas.deshpande@siemens-healthineers.com

Published by Siemens Healthcare GmbH · online · 1222 ·